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AMERICAN MACHINIST

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FRED. J. MILLER,
Editor.

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Some of the Leading Articles in this Number:

Americans and the "American Line."

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Chicago and New York Cycle Shows.

Increasing the Heating Surface of Boilers.

Electrotechnics.

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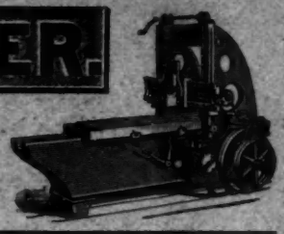

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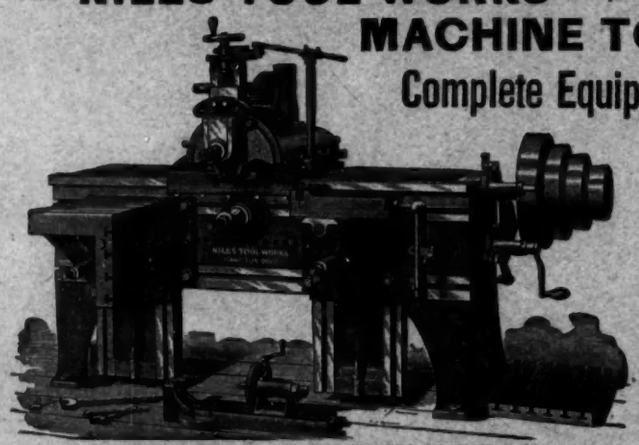

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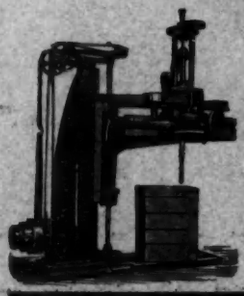

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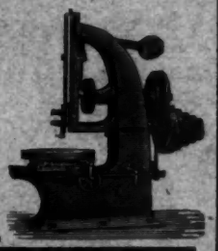

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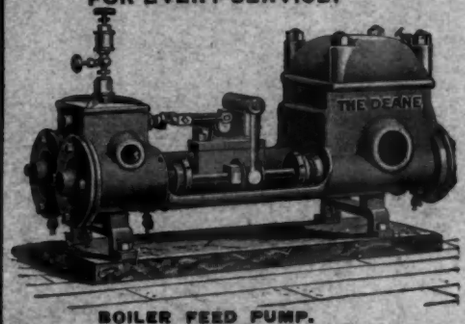

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The Forge Shop at the University of Nebraska.

BY PROF. C. R. RICHARDS.

Twenty-four of the Buffalo Forge Co.'s forges, equipped with their latest improvements, were installed at the University of Nebraska during the summer of 1894. This is one of the first shops to be equipped with this style of forge, and during the time it has been in use it has worked admirably.

Fig. 1.

The photographs and cuts will show clearly the general arrangement of the plant. The forge itself is one already well known. Instead, however, of exhausting the smoke through a cone-shaped hood and overhead mains, an adjustable hood or "cowl," pivoted at the side of the forge, catches the smoke, which is drawn downward through an underground main to the fan. When the fire is very smoky, the cowl can be lowered so that none of the smoke will escape into the room. Ordinarily, however, even with a smoky fire, the cowl may be raised out of the way, and the smoke will still go down the exhaust pipe. The arrangement is such that it does not interfere with the proper working of the forge.

The blast and exhaust are both carried underground in vitrified sewer-pipe mains. The ordinary bell-mouthed pipe was used, the joints being cemented and wiped smooth on the inside. An excellent conduit can thus be made. Each forge is connected to the blast main by a 3-inch galvanized iron pipe. The exhaust from the single forges goes through a 6-inch sheet-iron pipe to the underground main, while the double forges are connected together by a 6 x 6 x 8-inch Y.

Fig. 2.

FORGE SHOP, UNIVERSITY OF NEBRASKA.

As shown in the cut, the blower is "double-ended." It stands on the floor, being bolted to a heavy wooden frame, which is, in turn, anchored to a deep brick foundation. The exhaust comes up, and enters the fan through a 24-inch elbow. A part of the air and smoke enters the blast main, while the rest goes up the stack. In the stack is an elliptical damper, which is closed by the adjustable weight, as shown. When the blower is running, the air forces the damper open a certain distance, depending on the position of the weight.

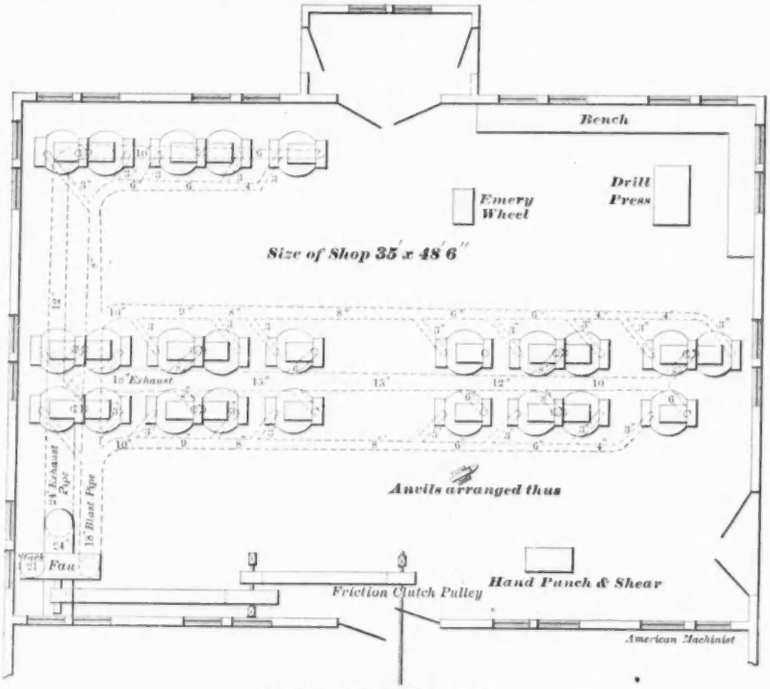
The pressure of the blast is a minimum and the exhaust a maximum when the damper is wide open, and, vice versa, the blast is a maximum and the exhaust a minimum when the damper is closed.

The blower looks like an ordinary steel-plate exhauster, the blast opening being concealed. It has ring oiling and water-jacketed journals. It runs at about 1,000 revolutions per minute.

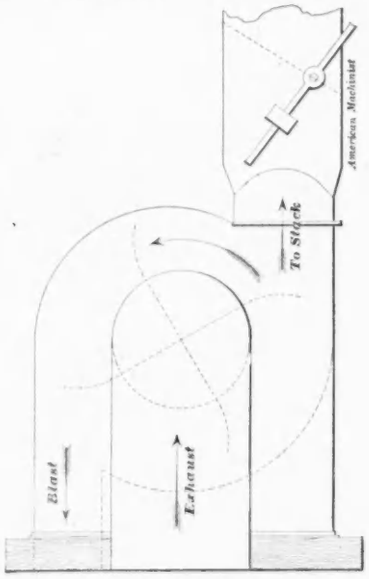
In order to prevent a dangerous explosion, should unconsumed gases be blown back through the forge, there are several safety valves (boxes with weighted lids) connected to the blast mains at various parts of the room. Once in a while there is a little explosion, but not of enough

force to do more than startle the students.

If the exhaust mains should become clogged with cinders, we can clean them out by closing all the exhaust openings except the one farthest from the blower, while the fan is running at full speed, with the damper wide open. The exhaust at the forge is so strong that a full-sized brick, held two or three inches away from the opening at the forge, will be drawn in like a nail to a magnet. This would certainly move any cinders that might have been dropped into the main, to a point where they could be cleaned out. Each successive forge can be treated in the same way.



PLAN OF FORGE SHOP.



EXHAUST FAN.

The underground system has a number of advantages: It does not cut off the light, as the old system does; it saves suspending a considerable weight from the ceiling; it makes a neater-looking shop; and is, altogether, a desirable improvement.

In some tests of the plant made last year, we found that the blower consumed 13.66 horse-power when running at 848 revolutions per minute (average of five trials); when running at 917 revolutions, the power consumed was 14.76 horse-power (average of ten trials); and when running at 961 revolutions, 17.6 horse-power was used (average of six trials). It then appears that the power (approximately) used to drive the blower varies directly as the square of the revolutions per minute.

The temperature of the gases at the fan, taken at the elbow, varied from 131 degrees Fahr. to 152 degrees Fahr. The temperature of the blast at the forges varied from 80 degrees to 100 degrees Fahr. The pressure of the blast varies, at different forges, from 1 inch to 1¾ inches of water, while the exhaust varies from 0.2 to over 1 inch of water. The exhaust pressure, measured at the elbow, varies from 3 to 4 inches of water.

Besides the equipment of forges, anvils and small tools, the shop contains a small hand forge, a 26-inch drill press, a wet and dry emery grinder, and a hand punch and shear.

[We must protest against the crossed belt shown driving the blower.—Ed.]

A Good Bearing.

The "Engineer," London, mentions, with high commendation, a step or bearing for an upright shaft which has been in constant use for sixteen years. The bearing is of phosphor bronze, and is loaded to about 480 pounds on the square inch. The upright shaft which rests upon it is 8 inches in diameter at the bottom, and, with the wheels, etc., upon it, weighs between 10 and 11 tons, running at 65 revolutions per minute. The cost of lubricating with castor oil has been about four cents per week. The step was put in use in 1879; and the shaft was recently lifted, and it was found in excellent condition, the wear being about 1-32 inch. If others wish to compare results with this, they should not fail to mention the load carried.

The Value of the Steam Jacket.

BY CHARLES T. PORTER.

The question is often asked by disbelievers in the advantage of the steam jacket, and that, too, with an air of triumph, which shows that they think it is a hard one to answer, "How can the jacket save steam, when in order to prevent condensation in the cylinder the same weight of steam has to be condensed in the jacket?"

I propose to answer this question, and to show precisely how the jacket operates to prevent loss of steam, and how considerable a saving is effected by it. It is important that the understanding of this subject be clear and definite. I shall do what I can to make it so.

To prevent misconception on the part of any one, it may be first stated, that a jacket has no communication with the interior of the cylinder. The so-called jackets through which the steam passes before entering the cylinder are not jackets at all.

The economic value of the jacket may be shown in a simple and conclusive manner, by following closely the phenomena which succeed one another during a single revolution of a steam engine —first, in an unjacketed, and second, in a jacketed cylinder.

The reader is first to be reminded, if he be not already familiar with it, of the elementary truth, that the steam engine is a heat engine—that is, an apparatus in which heat is converted into work, or in which atomic energy is changed into force acting through sensible distance, which is dynamic energy. This transformation is the only source of power in the steam engine; as motion of the piston against a resistance appears, a corresponding amount of heat disappears.

The relation of these two forms of energy to each other has been accurately ascertained. The amount of atomic energy that raises the temperature of 1 pound of water 1 degree Fahr. is the equivalent of the dynamic energy that will lift 772 pounds through 1 foot. One thermal unit is the equivalent of 772 units or foot-pounds of energy.

Let us now take a very simple case for examination. We will suppose a steam engine having a cylinder 18 inches diameter by 36-inch stroke, a single-cylinder condensing engine; and to make the case as simple as possible, we will suppose it to have no waste room at all.

Into this cylinder, now supposed to be unjacketed, we admit steam entirely free from water, at a total pressure, reckoned from the perfect vacuum, of 100 pounds on the square inch. It is cut off sharply at one-fifth of the stroke, expands on the Marriotte, or hyperbolic, curve to the end of the stroke, and is exhausted against a back pressure of 2 pounds, to which it falls instantly on being released.

The amount of work, in foot-pounds, done on one stroke is found as follows:

The terminal pressure is $100 \div 5 = 20$ pounds. The gain by expansion, cutting off at one-fifth of the stroke, is 1.609 times. To get the total mean pressure, therefore, we multiply 20 by 2.609, which gives us 52.18 pounds. Then deducting the back pressure, and disregarding the small fraction, we have a mean effective pressure through the stroke of 50 pounds on the square inch. The number of square inches in the face of the piston is 254.5, so that the total force is 12,725 pounds. This force acts through a distance of 3 feet, giving 38,175 foot-pounds of energy exerted. This number divided by 772 gives 49.45. So 49.45 units of heat must disappear in order that this stroke of the piston shall be made. This heat must be lost by the steam, which is the only source from which it can be supplied.

The number of thermal units contained in the steam is found as follows. Its volume is, $\frac{254.2 \times 7.2}{1.728} = 1.059$ cubic feet; 7.2 being the length of the stroke, in inches, up to the point of cut-off. The weight of one cubic foot of steam, at the pressure of 100 pounds, is .233 of a pound, and so the weight of steam admitted to this cylinder on one stroke is .24675 of a pound. ($1.059 \times .233 = .24675$.)

One step more and we shall find what we are after, namely, the heat that is brought into the cylinder. This is the real thing; the elastic steam is only the medium through which it is conveyed.

Now, the total number of thermal units contained in 1 pound of steam, at this pressure of 100 pounds on the square inch, is 1,213.85, of which 882.9 are heat of vaporization, and are lost when the steam is condensed, the temperature of the water remaining the same. So the total number of thermal units contained in this .24675 of a pound of steam is 299.5, of which 217.8 would be lost by its condensation. Of these 217.8 units we have got to have 49.45 units for conversion into work. How are we to get them?

In the first place, the total heat contained in the steam falls with the pressure, but to an extent sufficient to supply only a small part of this requirement. At the back pressure of 2 pounds, the total heat in 1 pound of steam is 1152.4 thermal units, and so that of .24675 of a pound is 284.5 thermal units. There are thus set free, on the fall of pressure, 15 units of heat ($299.5 - 284.5 = 15$); but where are the remaining 34.45 units to come from?

This steam cannot furnish them. By our conditions it is to expand on the hyperbolic curve, to which, indeed, in practice it very rarely goes down. But to keep up to it, it must not lose a particle of this heat, and so suffer condensation and consequent loss of pressure. Instead of a loss, it must have an increase of pressure. Steam does not expand on the hyperbolic curve, but on a curve that would carry the terminal pressure in this case down nearly to 18 pounds, instead of to 20 pounds. So, instead of being able to spare any heat, it must in some way receive more heat, in order to come up to the required terminal pressure. Expansion by superheat being out of the question, there must be nearly 10 per cent. added to the weight of the steam; for 5 cubic feet of saturated steam at 20 pounds pressure weigh very nearly 10 per cent. more than does 1 cubic foot at 100 pounds pressure. The exact figures are .2555 and .233 of a pound.

There is only one source of supply; that is the steam in the boiler. Enough steam, in addition to that shown by the indicator, must enter the cylinder before the cut-off, and be condensed on the interior surfaces of the cylinder, piston and heads, to supply the 34.45 units of heat needed for conversion into work, and also to increase the weight of steam at the end of the stroke nearly 10 per cent.

Let us follow this action a little carefully. The 34.45 units of heat needed require the condensation of a weight of steam equal to 16 per cent. of that which is shown by the indicator to be admitted to the cylinder, as measured at the point of cut-off, and that needed to keep up the pressure on the expansion adds 10 per cent. more. Thus, under the most favorable conditions—namely, dry steam, no waste room, sharp cut-off and expansion continued to the end of the stroke—in order that the stroke shall be made, and the terminal pressure be as required by the hyperbolic expansion curve, the steam entering the cylinder must be 26 per cent. more than is shown by the indicator at the point of cut off. This is the fact, and there is no getting away from it. The work is practically all done by steam that does not appear.

The next fact is the one on which the advantage of the jacket rests, and it demands especial attention. Of this steam, so condensed on entering and imparting its heat to the cast-iron surfaces, the 10 per cent. is re-evaporated on the expansion, increasing the steam pressure at the end of the stroke by nearly 2 pounds, as already mentioned, but the 16 per cent. is not re-evaporated. The cylinder gives up the heat first imparted to it by the condensation of this portion of the entering steam, but to be wholly converted into work. As heat it disappears. The water gets back none of it, but exists in the state of water at the instant of release.

On the return stroke, the internal surfaces, exposed to the low temperature of the condenser, are able to supply heat for the evaporation of all this water, and more if it is present, and are further cooled in the same degree. On the succeeding stroke, at least an additional 16 per cent. of the entering steam must be condensed, to fill the foregoing requirements, and also to restore to the surfaces the heat carried away by the re-evaporation during the exhaust, until this re-evaporation has reached its limit.

This last is certainly saved by the jacket, to the extent of its efficiency. The jacket, if completely efficient, supplies the 16 per cent. of heat, additional to the heat contained in the steam shown by the indicator at the point of cut-off, that is required for conversion into work, and also a portion at least of the 10 per cent. necessary to bring the terminal pressure up to 20 pounds. There is therefore at the end of the stroke no water in the cylinder to be evaporated during the exhaust. Its place is taken by the water in the jacket, which, instead of being evaporated to chill the cylinder in a still further degree, is returned to the boiler.

It seems to me that this economic action of the jacket is so obvious, that it needs only to be clearly seen to put an end to discussion on the subject.

Making Holes in Glass.

Strong glass plates are bored through by means of rotary brass tubes of the necessary diameter, which are filled with water during boring. To the water there is added finely-powdered emery. Thinner glass may be perforated with holes in an easier manner, by pressing a disk of wet clay upon the glass, and making a hole through the clay of the size required, so that the glass is laid bare. Molten lead is then poured into the hole, and lead and glass drop down at once. This method is based upon the quick, local heating of the glass, whereby a circular crack is produced, the outline of which corresponds to the hole made in the clay. When molten lead is poured upon clay so that steam is generated from the moisture, the lead is very apt to fly. Putty, although, of course, more expensive, is much to be preferred to clay for use in connection with molten lead.

Cycle Chain-Riveting Machine.

Machines adapted for riveting bycycle chains have undergone a complete change within the past year. By the new method the rivets are spun down instead of hammered, and a machine has been developed

in which the assembled chains are automatically fed through and the rivets effectively headed regardless of the varying distances between them. The machine we illustrate, made by the L. E. Rhodes Co., of Hartford, Conn., may be used for various work, as the riveting of bicycle pedals, etc., and consists of a pedestal open at its upper end, where two oscillating heads are closely fitted, swinging on a common pivot. Each of these heads has an arm extending downward within the pedestal, which arms are connected at their extremities by a toggle-joint mechanism shown through the open door. At the top of each of the heads are journal boxes carrying spindles, which are driven by separate belts and supplied with chucks holding the riveting tools.

These riveting tools are made to conform to the shape which it is desired the rivet shall assume, and, on chain machines, are constructed of two rolls. The spindles are provided with ball thrust bearings, and are adjustable by the knurled screws at either end.

Between the two riveters is the frame for the holding mechanism, consisting, in chain-riveting machines, of a sprocket wheel and a holding bar above it, whereby the chain is held securely while the riveting is being done. The sprocket wheel constitutes not only a holder, but also a feeding device, for it is keyed to a ratchet wheel having teeth alternately long and short; and to engage with these is a pawl, operated by the shorter of the two cam levers shown in rear view of the machine. The long lever, also operated by a cam, is for the holding device. Pawls are provided to prevent any back motion, and the sprocket can be adjusted to different positions, and can be replaced by others of different sizes to suit the various-sized chains. The driving mechanism consists of the cams, which are driven by the bevel gears, and these cams move the feeding and holding levers; and, secondly, the crank-disk, which is on the same shaft and is connected by a link with the toggle levers, which, spreading, oscillate the spindle heads. Two belts, running in opposite directions, drive the spindles at high speed.

The chain being placed in position for the first link, the holding block comes down upon it, and the toggle levers spread, bringing the spindles into bearing. The holding block then rises; the feeding lever actuates the pawl, and the sprocket is ratcheted along for the second rivet, moving to correspond to the varying spacings of the rivets. By using short or "dummy" rivets to connect a number of chains, the machine can thus be made to run entirely automatically.

This style of machine is preferred to the old one, both for the quality of the work done and for the amount. Compactness in design, with great strength for each part, enable a high speed to be used, while the riveting tools, meeting the rivet at a slight angle before moving to the final parallel position, reduce the great strain occasioned where it is tried to bring the spindles squarely on to the work, and render stops for adjustment less frequent. On rivets of ordinary softness, 6,000 can be spun over at both ends per hour. The machine, a little differently arranged, is equally adapted for riveting pedals.

A CHAIN-RIVETING MACHINE.

The Chicago Cycle Show.

Chicago's second cycle show closed Saturday, January 11th. It was an exhibition well calculated to give those familiar with machine work some adequate idea of the real magnitude and importance of the bicycle as an element of machine-shop production, and also of the bicycle demand as a factor in machine-tool progress.

To the mechanic, the cycle show just closed was an actual revelation. It gave a most emphatic answer to the question of the permanence of the bicycle as an article of manufacture. I do not think that the small arms and sewing machine and small machine tool manufacturers put together could give an exhibition of such magnitude, nor an exhibition showing such tool-making advance, and certainly no other mechanical show could attract such a multitude of spectators.

The cause is obvious: All other small machine manufacturers have interested certain small classes only, while almost every man, woman and child in the United States is a possible cycle user and cycle owner, and the entire small-tool resources

of the country are being taxed to their utmost to make bicycles. At the Pratt & Whitney stand at the Chicago Cycle Show, Clarence Whitney was presenting a "souvenir" in the form of a photograph, unfortunately not good enough for reproduction here, bearing the legend: "View showing part of Pratt & Whitney Co.'s new forge shop, now being used temporarily for assembling about two hundred screw machines for bicycle work, all of which are sold. December 23, 1895."

Such a photograph vividly illustrates the effect of the bicycle upon tool-building machine shops, and there can be no question that the present vast demand for cycles will cause the greatest imaginable advance in machine tools used in cycle construction; and these include all the previously known small tools and some new modifications so original as to almost form new types. Thus, Perkins, of Grand Rapids, long known as a very original machine designer in certain wood-working lines, now comes to the front with a cycle rim driller so divergent from previous practice as to be really a new tool. Perkins followed exactly the same course of thought pointed out in the "Cycle Tools" series in this paper, and answered the conditions with a single-spindle automatic tool, in which the spindle itself is varied in axial direction with each spoke hole bored, in a cycle of four changes, so as to drill a rim for any form of "lacing," as the spoke arrangement of a wheel is termed, with absolute correctness. This most interesting machine was completed barely in time to enter the Chicago Cycle Show, and will appear in the "Machinist" as soon as drawings can be prepared. Fox, of Grand Rapids, has added a third spindle to his rim driller for the air hole, and has also improved his chuck. Other notable machine exhibits were the Cincinnati Milling Machine Co.'s stand, that of the Prentiss Tool & Supply Co., a very remarkable development of the turret screw machine by the Lodge & Davis Co., and the Garvin exhibit. Garvin Machine Co. showed a set of hub tools which made the outside cut on over 5,000 cycle hubs without regrinding, which is certainly a most surprising advance over anything recorded in the way of metal-cutting.

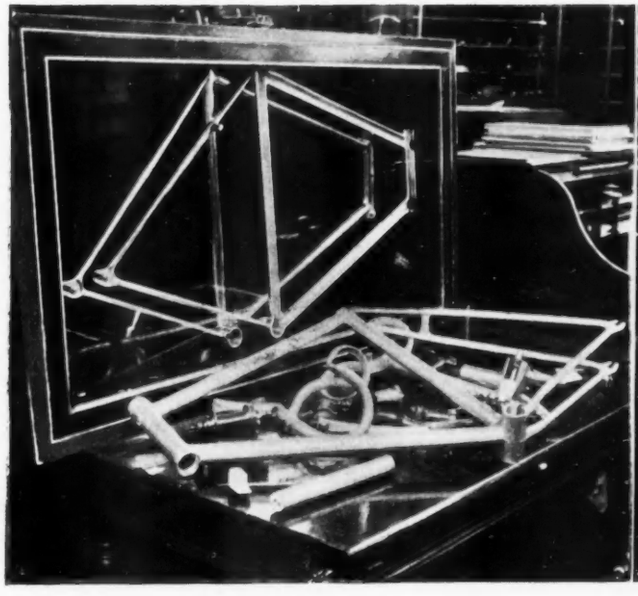
"Tattersall's," Sixteenth and State streets, Chicago, is a building of considerable floor area, and, with its annex and galleries, gave 398 "spaces" available for exhibitors, each of which was occupied by at least one, and many, in fact a great many, contained two or more exhibits.

There were on exhibition 1,060 wheels. Of these, 735 were for men's use, 229 for women, 81 tandems, 1 quad, 1 sextuplet, 6 carriers, 2 duplex, 1 hydrocycle, 1 tricycle and 3 unclassed. It is said that the manufacturers negotiated sales with dealers during the Show week, amounting to about $12,000,000 retail value.

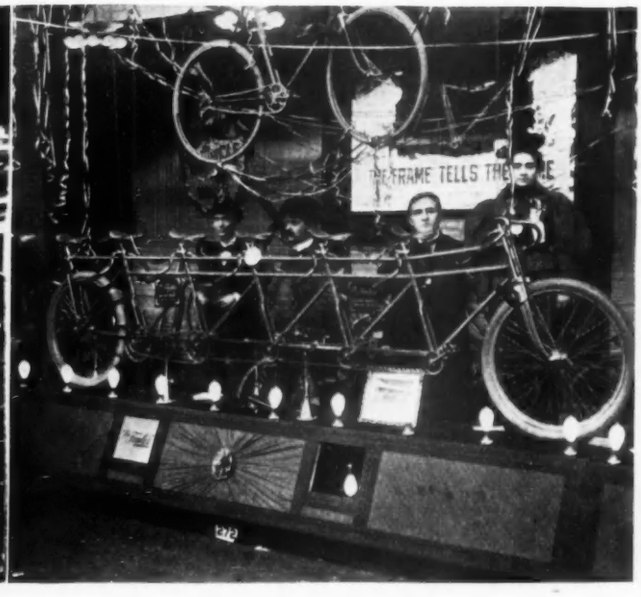
The 1,060 cycles on exhibition represented 400 different manufacturing firms. The 80,000 or 90,000 spectators came from within a radius of perhaps 200 miles of Chicago. These figures show the intense public interest in the bicycle, which is not an object of much thought except to actual or prospective users.

Perhaps the most noticeable exhibit, from a mechanic's point of view, was that of the "Luminum" cast-metal diamond frames, shown by the St. Louis Refrigerator & Wooden Gutter Co., St. Louis, Mo., and next to this easily comes the "Tonk" laminated hickory diamond frame. Both of these frames are distinct novelties in construction.

The "Luminum" frame, of which an engraving is given, is a very smooth, even, perfectly sound, single casting of a metal containing 96 per cent. of aluminum and 4 per cent. of unspecified alloy. The exhibitors claim that this metal, which they have named "Luminum," is a new composition, which is, bulk for bulk, about equal to the strength of the best wrought iron and only about one-third the weight, and that, weight for weight, "Luminum" tests to about double the strength of any pieced-up and brazed cycle frame, and that it even shows under test a higher tensile strength and modulus of elasticity than any steel made. It is also asserted that "Luminum" can be readily cast into any machine form, is not liable to crystallization from vibration, will not oxidize, and can be easily worked. The samples shown proved its suitability for the founder's use.



"LUMINUM" FRAMES.



A "SEXTUPLET."

A certificate from Prof. J. B. Johnson, Professor of Civil Engineering and Director of Laboratory Tests at Washington University, St. Louis, Mo., reads as follows:

Washington University,
St. Louis, December 23, 1893.

St. Louis Refrigerator & Wooden Gutter Company, City:

Gentlemen—I have to report the results of test on three specimens of your aluminum metal, cast December 6th, and tested by me December 7th. These, when turned down, beng 1.13 inches diameter, or exactly one square inch in cross section, and tested in reduced lengths of ten inches, showed ultimate tensile strength of 23,100, 25,400 and 25,400 pounds per square inch, respectively, or an average of 24,600 pounds per square inch. The average permanent set (stretch) of these specimens, before rupture occurred, is as one-half of one per cent. The metal is, therefore,

almost perfectly elastic up to the point of rupture.

Although I did not see this metal cast, I believe it to be the same of which your bicycle parts are made, so many of which I have tested.

The above tests were made with the greatest care, using my own extensometer, which readily records the stretch to the $\frac{1}{10000}$ of an inch. The modulus of elasticity of the metal is very nearly 8,000,000; that is to say, one pound strain per square inch will stretch the metal $\frac{1}{8000000}$ part of its length. This shows that it is 3½ times as elastic or springy as steel for the same area of cross-section.

Very respectfully,

J. B. JOHNSON,

Prof. Civil Eng., Dir. Test Lab.

Bearing in mind the weight of this alloy, it will be seen that it has qualities which may make it a very important element of future machine manufacture; and, owing to its extreme elasticity, it makes a very easy and fast cycle frame.

The laminated hickory diamond frame, invented by P. H. York, superintending partner in the Tonk Mfg. Co., 804 Hawthorne avenue, Chicago, is made of strips of hickory ⅛-inch thick, bent and cemented around a form to the shape of the diamond frame. This also forms an extremely light and elastic "fast" cycle frame, and it is claimed that it can be made for one-third the cost of the steel tube frame, and that it is in every way superior to it. The Tonk hickory "Diamond" is made both solid and hollow, one pound in weight being saved by the hollow form of construction.

The Novelty Mfg. Co., of Plymouth, Ind., the well-known wood rim makers, also showed a wooden diamond frame, an invention of Mr. Marble's. This wooden diamond is built up of tapering, round staves, fitted at the ends to metal sockets, and is thus an entirely different structure to the "Tonk," which is continuous, or in the single-piece form, the hickory strips of the "Tonk" being carried around pins in the mold or form, so as to make an eye for the crank hanger.

The Novelty Mfg. Co. also showed a bent-wood handle bar, which is as light as a metal handle bar, and much cheaper and less liable to injury from a tumble of the machine. This wooden handle bar received much commendation, and promises well.

Six parcels carriers were shown. The parcels delivery tricycle is becoming a very common feature in the streets, and furnishes a cheap and speedy means of "having it sent home," which in the old style sometimes involved half-a-dozen miles of horse, carriage and driver transit, to deliver a sale of ridiculously small cash value. It does not seem absolutely needful that the parcels delivery should have three wheels; and the use of three-wheeled machines in city streets involves delays and risks of collision which would not stand in the way of using a two-wheeler. A bicycle rider can carry a considerable load; and a narrow hamper on each side of the rear wheel would seem quite in the list of possible parcels deliveries.

The sextuplet shown by the Fowler Co. drew great notice. The framing, which is so very important in machines of this class, seems well designed, and appeared to meet with general approval. Like everything else shown in the way of regular factory work, this "Sextuplet" was very highly finished.

An engraving of a novel cycle, named the "Duplex," shown by the Wolf American Company, is given. The duplex carries two riders, side by side, and seems admirably calculated to promote sociability between users; the ordinary cycle riders seem rather a solitary lot of pleasure seekers, and the duplex is so well designed to obviate feelings of loneliness that it appears quite likely to fill a long-felt want.

A DUPLEX.

The Elgin Cycle Co. showed a $5,000 wheel, which was constantly surrounded by a crowd of observers. This machine is ornamented with 820 pennyweights of 22-karat gold in various colors, the ornamentation chosen being branches and leaves of colored gold, which can only be had in fine metal. The ornamentation also includes over 15 karats in fine diamonds, and 8 stones—3 of nearly 4 karats each, and 5 of nearly 1 karat each. This machine was designed by Mr. Thos. W. Duncan, president of the Elgin Watch-Case Factory Co., and is certainly a very beautiful piece of work; it does not look its value, but proved a very effective advertising agent. It is pleasing to the average citizen to reflect, however, that just as good a riding wheel can be had for a fiftieth part of the cost of this piece of magnificence, and not nearly so attractive to cycle thieves.

Another very noticeable exhibit was in the form of a gigantic wheel hub, nickeled, and polished to perfection; this was shown with a great number of pieces having hub, cone and cap cuts on them. Although it was an undeniably fine job of machine work, it did not hold the crowd to any marked extent.

The exhibit of the Fox Machine Co., of Grand Rapids, Mich., included one of his rim drillers, with a bevel-geared screw chuck, and an added third spindle for drilling the air hole. The air hole is so quickly drilled that the operator loses very little time by putting the rim under the air-hole spindle, when he has it in his hand, after completing the spoke-hole drilling. Fox also showed a pipe-cutter and other well-designed appliances for cycle-makers' use.

Garvin Machine Co. showed heavy hub-making tools, wheel-truing machines, a 2-spindle hub flange driller, and other machines.

Perkins & Co., Grand Rapids, Mich., showed his new single-spindle rim driller, which drills a rim without attention after it is once put in the machine, in 40 seconds, and stops automatically when the drilling is complete, and drills the holes with absolute correctness for both the spread and tangent angles, as previously mentioned. Perkins also showed a pipe-cutting attachment for the upright driller, a very cheap and effective rig.

Lodge & Davis showed a single exhibit, the screw machine for making cycle hubs, shown in the "Machinist," January 9th. This is a very powerful machine in appearance, and its builders are not at all shy in proclaiming its merits. In the show, it has a large sign with the legend: "The Fastest Hub Machine." The turret has a horizontally-flanged base, fitted to take tool-posts—an arrangement I have not before seen. The finish was good, and the machine looks like good work and a big output.

The Prentiss Tool & Supply Co. had quite an assortment of tools in evidence, including many adapted to the use of the cycle repair shop, and some solid felt and leather emery wheels, which were noticeable.

The Pratt & Whitney Company had a small exhibit—probably large enough while they are using their forge shop for assembling screw machines sold before the castings are made.

In addition to these makers of regular machine tools, there were a number of displays made by makers of specialties designed expressly for the numerous cycle repair shops which are in operation all over the country. Among these, a noticeable exhibit was that of the Richards Mfg. Co., 218-220 Fulton street,

Brooklyn, who put out a small and very inexpensive index milling machine, good enough to have cut the wheels of a running clock which was made part of the display. The same company furnishes a foot-power driller with stand and chuck, and a small grinding stand.

In addition to these machine tools, there were several exhibits of gasoline and compressed air "Braziers," or "Brazers;" those of the Turner Brass Works, 122 Kinzie street, Chicago, and Eugene Arnstein, 113 Franklin street, Chicago, I noticed particularly. Fox, of Grand Rapids, also showed brazing fire burners for factory use. Other brazing fires were shown by Perry & Ransom, Oshkosh, Wis., with large and convenient firebrick tables; and the White Mfg. Co., 40-42 State street, Chicago, exhibited a variety of adaptations of the gasoline "Blow Torch" in different sizes—from a hand air-bulb blast for jewelers' use, up to their two and three-burner "Mammoths," all well adapted for their particular uses.

This notice of the Chicago Cycle Show would be incomplete without mention of the wonderfully fine printing given away in the form of catalogs by the exhibitors. Very much of it was in the highest plane of the art, really exquisite work, both in engravings and letter-press, and the text of many of these catalogs was of real interest from a literary point of view.

Altogether, I am quite safe, I think, in pronouncing this Second Annual Chicago Cycle Show one of the most impressive exhibitions of machine-shop manufactures ever made in the United States.

HUGH DOLNAR.

Increasing the Heating Surface of Boilers.

BY F. F. HEMENWAY.

A good deal of attention has been given, at one time and another, to the proper relation between the grate surface and the heating surface of land boilers, until the matter, one would think, had come to be pretty generally understood. But the trouble seems to be a sort of common feeling, hard to understand, that the boilermaker who has put driving rivets and calking seams behind, in the hopes of bettering his condition by making boilers to sell, knows nothing of this. It is an idea without sense. The boilermaker builds a boiler to do a certain fixed amount of work, with the same confidence that the steam engine builder builds a steam engine. I am writing now of the boilermaker, and not of the country blacksmith who essays to build boilers solely and simply because he thinks there is "money in it." There are more than plenty who do this; but it does not follow that a man should buy a boiler from such a party. It is a matter of choice. Responsible boilermakers will furnish a customer with just what he wants and orders, and they know what they are building. Notwithstanding this, the world is full of those who are anxious to help him out of his supposed or presumed ignorance.

This is particularly and mainly true in regard to increasing the heating surface of his boilers, as if he didn't know, or by any possibility could not have known, what he was doing. More heating surface seems to be the shibboleth with all who start out with something with which to magnify a steam boiler. It is one of the principal causes of uneasiness. As has been remarked, this matter seems to have been pretty fairly well settled in the way such things are generally settled—that is, by tentative process; but this seems to make no difference to those who are imbued with a yearning desire to help the boilermaker. From time away back it seems to have been a prevailing idea, that if to the boilermaker's best intentions and best practice more heating surface could be added, by some supplementary process, all his shortcomings would be things that had gone by.

My mind has been turned to this during the past few weeks, by noting, in the technical press, the manner in which a certain —perhaps uncertain would be better—arrangement of pipes to entrap some of the escaping hot gases was being exploited. Adding to the heat surface—the idea is an old one; horizontal pipes, vertical pipes, and pipes at all inclinations; pipes running this way and pipes running that way, pipes running any way so as to gain heating surface; but I never heard of anything of importance coming from them.

It is worth considering what this added heating surface amounts to. As has been said, a boiler is made with a fixed purpose in view, just as much as a machine is made for a definite purpose. You can block up a 20-inch engine lathe so that it will swing 30 inches; but it is something that is not resorted to except in a temporary emergency, or for an occasional job. You suppose the builder of the lathe knew how to proportion its parts for a 20-inch swing. Just so with the boilermaker. He knows what is required to accomplish certain ends. To assume that he does not is to assume that he is a fool, so far as his business is concerned. The whole matter pertaining to boiler economy is so intermingled with the necessity of temperature to produce chimney draft, as not to bear too much meddling with.

Any boilermaker of intelligence—and it is poor policy to deal with any other—knows that he can get the most work from a boiler when the escaping gases are of a high temperature, and the best economy when they are of a low temperature, and he will construct boilers to suit the views of his customers in these respects. This is being done every day; making one for the most work or for the highest economy; providing the additional heating surface, if desirable, right in the shop where it ought to be provided.

Mind, I do not say that there may not sometimes be a gain by the use of pipes, in the furnace and beyond it, of a steam boiler; but when this is the case, the construction was originally faulty; and, in any case, I should personally object to the pipes. Pipe joints of whatever kind are objectionable, always, when exposed to rather intense heat. The danger of their failure is great, when the additional heating surface is gained by more or less cutting of the boiler shell. It has come to be a maxim, if it has not passed to formula, that, with the modern high-pressure steam employed, a boiler should be cut as little as possible for the attachments. Following what seems to be the inevitable, as steam pressure becomes higher boilers become relatively, weaker; and the shell and other parts should not be further weakened, when doing so is avoidable. The introduction of pipes calls for the cutting of more holes; a matter which should be well considered. It may be said that just a little more cutting does not amount to much; but the logical conclusion from this would be that it would not amount to much if still more holes were cut, until the boiler proper was mainly a thing of holes.

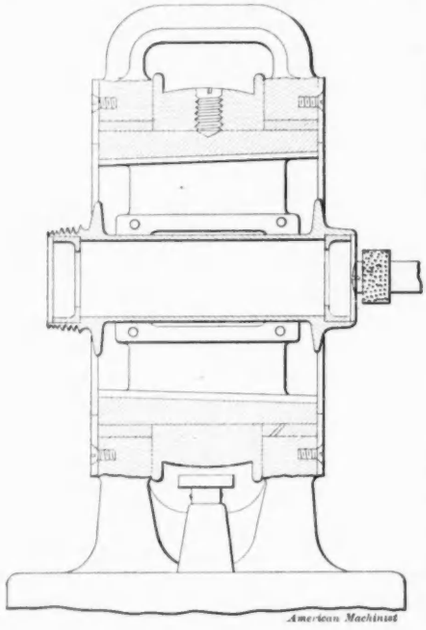
It is not, always, the added heating surface that is to be objected to, but the manner in which it is obtained. But the additional heating surface is not always desirable. I have reasons for remembering the test of a steam engine, three boilers being used for supplying steam. The first result of the test was not satisfactory, and on the second day one of the boilers was cut out, when what was desired was obtained, notwithstanding the reduction of heating surface.

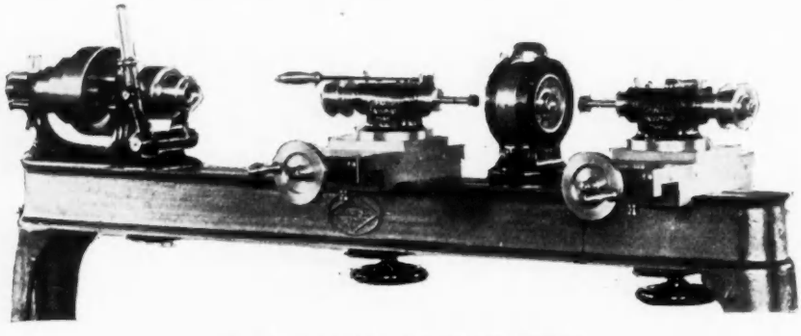
Some ten years or more ago it was essayed to put a wonderful "economizer" on the market; big stock company, and all that. There was so much pipe about the arrangement that you had to trust to imagination as to the location and general shape of the boiler—and, by the way, there must be a good many pipes in order to materially increase the heating surface. I never heard of it after it had been applied to two boilers. I only know that I incurred the lasting enmity of one of its promoters by venturing to say a word as to what I thought objectionable about it, particularly the vast array of pipe joints exposed to high temperature.

If you have a boiler that permits the gases to escape at too high temperature, the remedy—and in the end it is likely to prove the cheapest remedy—is to buy a new one, bearing in mind that heat is necessary for producing chimney draft, as well as for imparting heat to water, and in any event no important change should be made in a boiler except by advice of a competent engineer known to be reliable and disinterested.

Grinding Machine for Ball Bearings.

We illustrate herewith a machine for grinding ball bearings. Originally the machine was intended to grind only one end of the bearing at a time, and the chuck in which the bearing was held was therefore made to turn upon its base, just half-way around, the two positions being defined by a stop pin. Later, however, the second grinding head was added, which not only enables the grinding to be done more rapidly, but insures that the two bearings shall be precisely true with each other.





BALL-BEARING GRINDING MACHINE.

We give a sectional view of the chuck in which the hub is held. There is a split collet, which is tapered externally to fit the revolving ring, which is driven by a belt.

The wheel spindles are set to position by the hand wheels shown, and are moved in and out of the bearings by the levers, which move pinions that engage with a rack formed on a sleeve, within which the spindles run.

The head at the left is fitted with a draw-chuck adapted to hold cones and other parts that are to be ground, the chuck being opened or closed by a movement of the lever. When using this head, the grinding spindle adjacent to it is turned upon its base, to bring the wheel into working position. The machine is made by the Diamond Machine Co., Providence, R. I.

The Comparative Efficiency of Belts and Ropes.

From the time of the earliest adoption of fibrous ropes for power transmission much controversy has raged around the question of increased loss of useful effort which their use is supposed to entail. Now and again we find it stated by mechanical engineers, who ought to know better, that ropes, at best, are simply cheap substitutes for belts, and, as such, their use should be discouraged by all who aim at securing the greatest efficiency in transmitting power. At best, they are only to be tolerated as temporary expedients which the high-toned designer will only condescend to consider when all else fails to meet the conditions of the case.

In England one does not find the same distrust of rope driving, and almost the only individuals who can find no good word for this system of power transmission are the makers of leather and woven belting. But even their efforts to disparage rope driving altogether lose point when it is remembered how many scores of mills and factories in the north of England are rope driven, and how spur gear and belting are steadily losing favor for the transmission of both moderate and large amounts of power.

But force of circumstance and general convenience have had much to do with the rapid change in transmission systems, and the thoughtful mill owner has always had a tolerably well-rooted conviction that he was paying somewhat dearly for being in the fashion. He had heard that ropes occasioned considerable loss of power by sticking in the wheel grooves; that no two ropes of a set could be trusted to pull alike, and that a deal of power was wasted in bending and straightening the rope as it passed over the pulleys. Small wonder is it then that, under these circumstances, he was quite ready to believe that rope gear absorbed an additional 5 per cent., or more, of the power, as compared with belting, even under the most favorable conditions, and when erected in the light of the best modern practice. Experiments made to decide the relative efficiency of belt and rope driving have been very few, and the results have furnished such a mass of contradictory evidence, that it is impossible to draw any reliable conclusion. The recent experimnts carried out at Lille by the Société Industrielle du Nord de la France are, however, worthy of more attention, and it is gratifying to note that two papers on the results obtained in these trials have just been read before the British Institution of Mechanical Engineers. These tests were carried out under the direction of a body of more or less eminent engineers, who presumably had no bias. In some of the previous experiments, one is driven to the conclusion that they were made with the express object of exhibiting all the virtues of the one system and all the defects of the other in a most unmistakable fashion. We have only to consider the experiments of M. Fauguier, in 1893, to see how ridiculous rope driving can be made to appear, if only one selects ropes large enough and pulleys sufficiently small. It is therefore important to note that the dimensions of ropes, belts and pulleys used in the Lille experiments were in every respect representative of ordinary modern practice—in fact, the whole series of trials seems in every way to have been carried out in a manner which, whatever else may be said of them, was eminently practical. Broadly, the results of these trials show very conclusively that properly arranged rope gear is quite as efficient as belt driving, and perhaps this is, after all, what the power-user is most desirous of ascertaining. From a scientific point of view, the trials are, however, distinctly disappointing, for no attempt was made to compare the two methods of transmission at various speeds, and no one seems to have thought of trying cotton driving ropes, although a cotton belt was among the number tested.

Briefly, the method adopted in these experiments assumed that, given a constant resistance, any variation in the efficiency of the method of transmitting the power necessary to overcome such resistance will produce a corresponding variation in the amount of power supplied by the generator. In carrying out the tests, a 200 horse power horizontal engine was provided with two fly wheels, each about 16 feet 4 inches in diameter. One of these was grooved for five manilla ropes, 1¾ inches in diameter; the other was turned to receive a belt, 17¾ inches wide. A dynamo, provided with two corresponding pulleys, about 5 feet in diameter, was alternately driven by the two systems, care being taken to maintain the load constant throughout the trials. The resistance was provided by a number of incandescent lamps. Any variation of efficiency of the transmitting media would manifest itself in the power developed by the engine, and accordingly this was carefully ascer-

tained at frequent intervals, a set of four indicator diagrams being taken every ten minutes.

The following condensed table gives the principal results:

	Belts.			Ropes.
	(1) Lechat's Cotton.	(2) Lemaire's Leather.	(3) Domange's Leather.	Saint's Manilla
Indicated H. P.	159.67	158.84	160.23	158.54
Mean speed of engine.	79.05	79.08	79.23	78.46
Mean speed of dynamo	261.08	260.72	261.73	260.78
C = circumferential speed of fly wheel, ft. per sec	67.75	67.78	67.82	67.16
c = circumferential speed of pulley, ft. per sec.	67.23	67.13	67 29	66.93
Slip $= \frac{C-c}{C} \times 100$. (s)	+0.780	+0.961	+0.780	+0.329
Cross section of ropes or belt in sq. in.	6.63	8.72	7.54	8.00
Tension on belts or ropes at fly wheel (lbs. sq. in.)	176.08	132.98	155.02	155.02
Tension on pulley (lbs. sq. in.)	177.35	134.40	156.16	156.45
Weight of ropes or belts	332.8 lbs.	330.7	293.2	418.8
Relative power absorbed taking ropes as 100	100.87	100.37	100.07	100.00

Rope fly wheel.....16.358 ft. diameter.
Belt " " .....16.3.2 " "
Rope pulley..... 4.925 " "
Belt " ..... 4.922 " "

An inspection of the table shows that, under the conditions given, the ropes had the advantage in almost every respect. One point especially worthy of note is that the width of the fly wheel and pulley for the ropes was only about two-thirds that required for belt driving. Any advantage due to the narrower and probably lighter, wheel, was, however, more than balanced by the increased weight of the ropes, but if these latter had been of cotton, they would have been considerably lighter, and, moreover, would have offered less resistance to bending in passing around the dynamo pulley. It will be observed that the latter was slightly larger than the minimum of 30 rope diameters would require it to be, but for manilla ropes there is no doubt that 40 rope diameters should be taken as the least diameter consistent with satisfactory working. It should be mentioned that the ropes were allowed to run under one uniform tension. On the other hand, the tension on each of the belts was regulated (by adjusting the position of the dynamo) by the belt makers during the trials. This would introduce one more element of uncertainty into the test. The tensions given in the table are only the effective tensions, and, as it is impossible to tell what the absolute tight and slack side tensions were, it is just as impossible to say how much power was lost through abnormal initial tensions. It is scarcely likely that the variation in this respect would be very great, but it might conceivably be sufficient to account for the comparatively inferior results obtained from the belts in some of the trials.

It will be noted that the slip, as given in the table, is much greater in the case of the belts than with the ropes. It should, however, be observed that the effective radius of the belt pulleys has been taken from the center of the shaft to the surface of the rims, while the rope slip is calculated on the assumption that the effective radius is from the centre of the shaft to the centre of the rope, when at rest. It is difficult to explain why the ropes have been thus favored, for it is tolerably evident that the effective diameter of the belt pulleys should be taken to the centre of the thickness of the belt, which would modify the percentage of slip of the belts considerably. Thus in (1) the slip would be .333, in place of .780; in (2), .368, in place of .961, and in (3), .241, in place of .780.

It must be confessed that the actual results obtained from the Lille experiments are considerably less than might reasonably have been looked for. A unique opportunity of securing valuable experimental data appears to have been turned to but little account; for although it is desirable that the conclusions arrived at should be firmly established by comparative experiment, it is a matter for regret that the inquiry was not extended to measurements of the absolute loss of power which each system entails. Even such a simple expedient as the removal of one of the ropes does not seem to have been resorted to, notwithstanding that, in the light of the most modern practice, four ropes should have been sufficient to transmit the required power. No great difficulty stood in the way of trying ropes of cotton and hemp, yet neither was considered, while certainly trials involving variations in speed and power could very readily have been made. Finally, smaller ropes—five of 1½-inch diameter, for example—would doubtless have given better results, and would have been more in accordance with the tendency of modern practice. There can be no question as to the importance of the question at issue, and it would seem a fitting subject to commend to the notice of some of the more enthusiastic students of our technical colleges for further experimental investigation. M. E.

Calcium Carbide and Acetylene Gas.

Probably the latest and biggest of "bargains" that have stampeded the industrial world, is acetylene gas. The most alluring promises were made in its behalf, and we are already reaching the point where some of the bargain hunters are beginning to figure up their profits and losses. The calcium carbide was to be produced at a cost of from $5 to $7 per ton. The latest information seems to put the practical cost at about $70 per ton. An investigator lately bought calcium carbide in this city for 75 cents per pound, and the lowest quotation obtainable was 50 cents per pound, in lots of 100 pounds, or at the rate of $1,000 per ton. In connection with this business, some fine work has been done by patentees and promoters, which matter the "Engineering and Mining Journal" has been investigating for the benefit of the public. The following questions, proposed by the journal referred to, are waiting for answers:

"1. Is it true that there are and can be no patents covering the substances calcium carbide and acetylene?

"2. Is it true that the patent for the Willson process for producing calcium carbide is worthless; that, in fact, the production of calcium carbide in the arc electric furnace is free and not subject to monopoly, and that it is being produced by others in Europe without any regard to the Willson patent?

"3. Is it true that the Willson Companies, the Electro Gas Company, or those interested in promoting them and selling their securities, have made public statements for the guidance of investors, that they can make calcium carbide at from $5 to $7 per ton, or in more recent statements at $20 per ton?

"4. Is it true that none of these companies has ever produced or can to-day produce calcium carbide commercially at these figures, or at a cost even seven times as great?

"5. Is it true that no one prominent in these concerns who has known that these public statements were and are absolutely unfounded has ever publicly protested against the use of these statements, or has made any truthful public statement of what it actually has cost, and now costs, to produce calcium carbide or acetylene by their processes?

"In short, are these enterprises selling 'rights' which have little or no intrinsic value, or are they able to prove the public statements made for them that they are producing acetylene at figures that give it commercial importance?"

A Governor Belt Breaks and a Fly-Wheel Bursts.

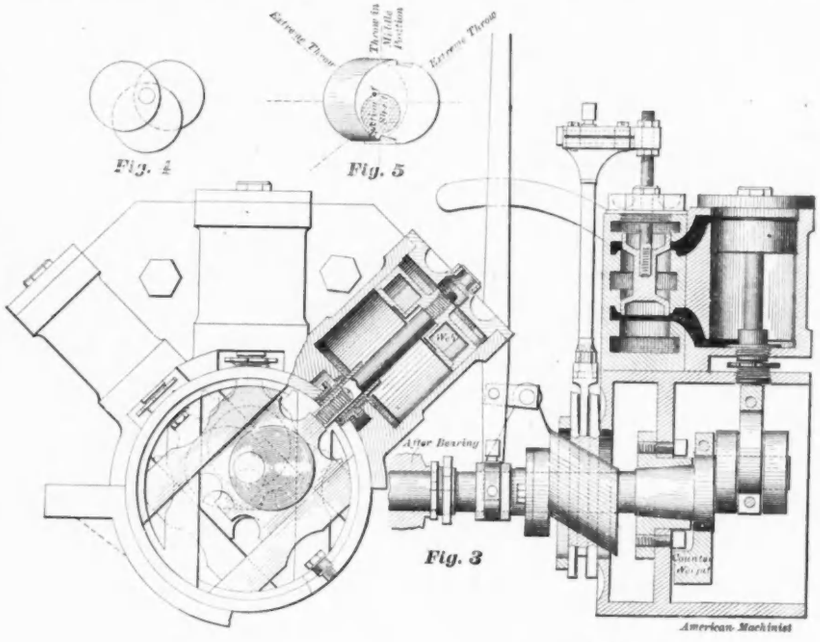
A 16-foot fly-wheel, weighing 16,000 pounds, burst recently in a paper mill at West Manayunk, Pa. The cause of the accident was the breaking of the governor belt. One piece of the wheel, weighing more than a ton, was thrown through the roof and over the Reading Railroad, in its flight cutting off a limb 12 inches in diameter, from an elm. Only a cat was killed. Damages to buildings and machinery estimated at $4,000.

If our friend who signs himself "Tramp Machinist" will send us his correct name and address his communication may receive some attention, otherwise it will go into the waste basket.

A Condensed Engine.

We take pleasure in laying before our readers some views and a slight description of one of the most remarkable steam engines that have ever come under our notice, with the assurance that it will well repay the effort necessary to accomplish a complete understanding of it. The engine, as yet, has never been out of a small country shop; but we are satisfied that a larger world should know of it. The engine has been especially designed for a marine engine, with a low center of gravity and extreme compactness. The striking features of the engine are in the means by which the movements of the pistons are communicated to the crank, and in the valve motion. The crank movement is a challenge to the antiquarians, and, as far as we know, is a novelty. The engine shown is small, but is running quite successfully, being used to drive a fan, 36 inches in diameter, at 650 revolutions per minute. The fan has six blades, with 1 square foot of area each, and set at the angle offering the greatest resistance; and the inventor tells us that it takes so little steam that there is scarcely any perceptible exhaust. It has been run light to more than 1,200 turns a minute, with a glass filled to the brim standing on the steam chest, without spilling the water.

The three cylinders of the engine (triple-expansion) are, respectively, 1⅞, 2½ and 3½ inches in diameter, and 2½-inch stroke. The first peculiarity of the engine is that the throw of the crank is only one-half of the piston stroke. The crank pin is long, and turning freely upon it is a bunch of three eccentrics, made of a single block of metal. The eccentricity of each eccentric is the same as the throw of the crank. Each eccentric is 90 degrees in advance or behind the next one, or the outside ones are opposite each other and one is midway between them. The engine cylinders are each in advance or behind each other sufficiently to bring each cylinder central over one of the eccentrics. The middle cylinder is vertical, and the axes of the other two stand 45 degrees from the vertical. The piston rod of each



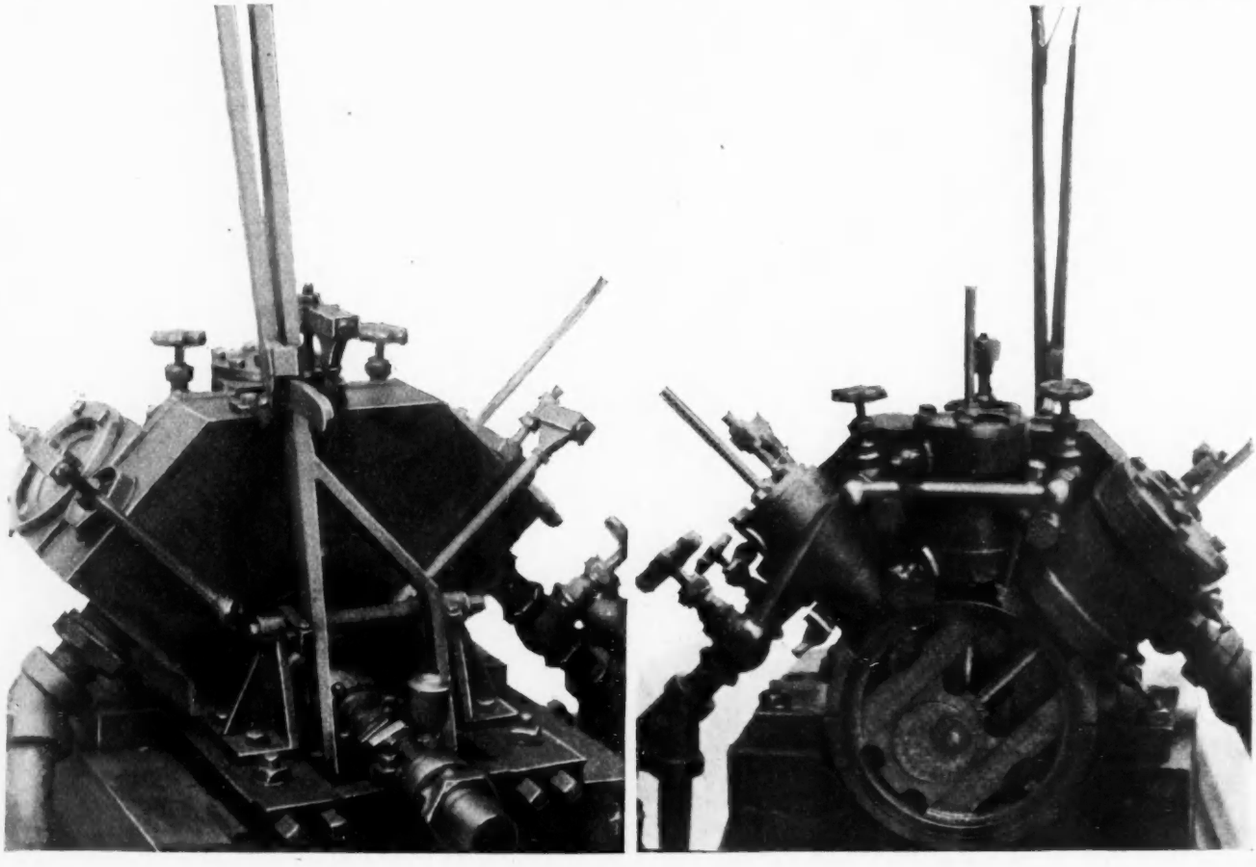


Fig. 2. A CONDENSED ENGINE. Fig. 1.

cylinder is attached to a thin crosshead, long enough and broad enough for the eccentric to turn in, the crosshead being guided by suitable fixed slides parallel with the piston rod. When the crank is turning, the eccentrics turn on the crank pin in the opposite direction and at double the speed. When any piston is at the end of the stroke, its eccentric is in line with the crank, and the eccentric throw is outside of and added to the throw of the crank. When the piston is at the middle of the stroke, the eccentric has made a half revolution upon the crank pin, and a quarter of a turn in the crosshead, so that its throw is, in relation to the crank, all inwards, and compensates for the throw of the crank, and brings the outside of the eccentric central in the crosshead. When the piston gets to the other end of its stroke, the eccentric has made a complete revolution of the crank pin, or, rather, the crank-pin has turned a half revolution in the other direction, and the throws of crank and eccentric are again together. Fig. 1 shows the piston of the front cylinder at the lower end of its stroke, and the centers of crank and eccentric are both also in the central line of motion for that piston. The same operation goes on at the same time for the other two pistons, their eccentrics, each helping and relieving the other, so that there is very little pressure or friction upon the slides. The irregularity of movement due to the angularity of the connecting rod is entirely eliminated in this engine; and for each cylinder, when its piston is in the middle of its stroke, the crank also is in relation to it, also midway in its revolution. The relief of the slides from pressure is shown by the fact that the shaft and crank may be removed and the pistons will cause the crank-pin hole to describe a true circular path, just as if the pin were there.

Piston valves are used, taking the steam in the middle and exhausting at the ends. The steam passes from the first valve, through the triangular space between the cylinders, to the next valve chest; and so on. One eccentric is used for all the valves, for both forward and backward motions, with separate eccentric straps and rods for each valve. A hole in the eccentric is bored obliquely, and an oblique cylindrical sleeve is slid back and forth upon the shaft, changing the throw of the eccentric, or reversing it for running in the other direction.

Many of the details of the engine will provoke criticism. The conical main bearing, it will be seen, is without collars; but the shaft is held in position endwise by adjustable collars fore and aft of the after bearing. The crank pit is to be entirely inclosed and flooded with oil, to insure thorough lubrication. The piston rods run through babbitted sleeves, which have a limited lateral movement if required. When the reversing lever is in the middle position, the throw line of the eccentric is in the same plane with the crank; and, as the valves have a steam lap slightly greater than the travel, when the eccentric is at this point no steam is admitted.

The illustrations explain themselves. Figs. 1 and 2 are from photos of the front and back of the engine. Fig. 3 is a reproduction of the original drawing of the inventor; and as he is not a professional draftsman, no explanations are necessary, and certainly no apologies. Fig. 4 is a plan of the group of driving eccentrics, and Fig. 5 of the oblique sliding sleeve for the valve motion.

The inventor and constructor of the apparatus is Mr. Frank Cary, Penn Yan, N. Y.

Mechanical Bargain Hunting.

The same human nature belongs to all mankind—and womankind. It crops out, like the underlying rock at places far apart. It is human to love a bargain and to run after it when in sight, and manifestations of this propensity occur continually. It is supposed that some of our dry goods stores could not exist were it not for the continual allurement of bargains. The hope to get something for less than its value is, however, not quite so seductive as to get something for nothing, and the curious thing about it is, that, next to the feminine frequenters of the bargain counters, those most frequently entangled by these devices are to be found in mechanical circles. It is very proper, in the nature of things, that the pseudo-mechanic who to-day is offering the biggest bargain, or the most for the least, in the mechanical world, should have a woman for his most persistent backer.

Mechanical bargain schemes are always appearing. Perpetual motion is by no means dead, and next after that come the various schemes for utilizing the forces of nature; the winds and the waves and the tides are favorite subjects for visionary inventors and credulous capitalists to manipulate in their minds. As we write, there is before us the prospectus of one of the freshest of these schemes. This time it is the waves of the ocean that are to propel the ship from land to land, and around the world if necessary. Of course, when a ship is at sea it must do a great deal of pitching and rolling, and it is equally evident that great power is employed to cause this motion; and a reasoning mind, especially if running without a governor, can easily figure it out that this power may be appropriated to man's purposes. A swinging cargo is to be attached to an air compressor; and every motion of the vessel, whether pitching or rolling, and however slight, is to help to compress the air, and the air is to drive twin screws and send the vessel riding over the waves. We are told that a model of this invention was recently tested in Narragansett Bay; "and so successful was the trial, so apparently practical and simple was the design, that a company was formed and capitalized for $250,000. This company will be known as the parent company, and all the stock it is intended to sell has been disposed of. New York and Boston capitalists are now considering the advisability of forming a syndicate to control the sub-companies in this country. The outlook for the promoters is very bright."

This is only one scheme. Others of various magnitude and promise of success are springing up all around. Wherever there is a waterfall there is always something for nothing, and the favorite mechanical bargain of the hour is some scheme of long-distance power transmission. With a coal mine and a waterfall side by side, the development of any given power, up to the limit of the water power, may be cheaper by the water than by the coal. At a certain distance, the water power and the coal power may cost the same. At a greater distance—certainly, if the distance is sufficiently great—the coal power will invariably be the cheaper. For transmission of power to the greatest distances, a wire or a pipe is not to be compared with a line of rails and a train of cars.

It is not mechanics, after all, who run after bargains. There are no mechanical bargains. A fair price must always be paid for all results obtained. Cause and effect are so interdependent that the latter can never ultimately outweigh the former. It is the quasi-mechanic, or the pseudo-mechanic, or the mechanical charlatan who runs the mechanical bargain counter.

It is stated that arrangements are being made for a race between a sextuplet and the Empire State Express, which has a record of one mile in 37 seconds. It is proposed to have the race in April, the sextuplet to have a three-mile course of asphalt, with a half-mile flying start. The big machine is to be ridden by six of the fastest racing men.

The "Saturday Review," London, has this terrible thing to say about Cecil Rhodes, of current South African fame: "And he is strong with the strength of a coarse, greedy egotism, the strokes of whose piston rod force the minds and the money of weaker men into its reservoir."

John F. Ward, Mem. Am. Soc. C. E.; H. Waller Brinckerhoff. Mem. Am. Soc. C. E.; and Wisner B. Martin, Assoc. Mem. Am. Soc. C. E., have taken offices together in Aldrich Court, 45 Broadway, New York City, as consulting civil and mechanical engineers.

ELECTRICAL MACHINERY.

Electrotechnics—V.

The Principles of Electricity for Practical Men.

BY FRANK S. MASON.

16. THE RELUCTANCE of air to the passage of the magnetic lines is much greater than that of some other mediums, notably iron and steel, being, in fact, some hundreds of times greater than that of iron. Furthermore, the same law of fluid motion which governs the flow of the electric current applies also to the magnetic circuit, viz.: The magnetic flux = the magnetic motive force / the reluctance.

It follows that, as with the electric current, the best construction to give highest efficiency demands a medium of high conductivity, an ample area and a short path—since, if the length of the conductor is increased or the area restricted, the resistance manifestly is increased.

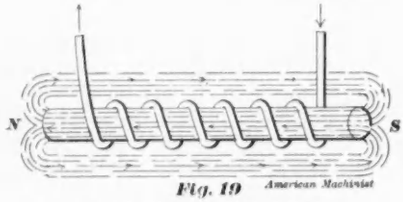


Fig. 19 American Machinist

A BAR ELECTRO-MAGNET.

Upon introducing within a solenoid a core of iron, Fig. 19, the magnetic properties are vastly increased—not because it is any more of an electro-magnet than before, or another kind of an electro-magnet; but simply because an easier path has been provided for the magnetic flux.

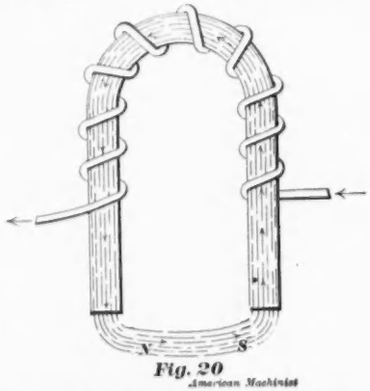


Fig. 20 American Machinist

A HORSESHOE ELECTRO-MAGNET.

A solenoid with a core constitutes the so-called "bar magnet." This is the least efficient form, since the magnetic flux must return through an external field of air a distance equal to the length of the bar. If bent to a horse-shoe form, Fig. 20, the efficiency is much greater, since the magnetic lines may now take a short cut across from pole to pole. As illustrated, the length of the core is excessive, and the efficiency may be further improved by adopting a more chunky form—Fig. 21. By adding an armature, Fig. 21, the air gap is further reduced; and if the armature is placed in contact with the poles, Fig. 22, the magnetic circuit is nearly as perfect as the reluctance of the conducting medium will permit. Nevertheless, the joints betwen the armature and the poles, no matter how perfectly surfaced, still offer more resistance than the iron itself, and there will be some external leakage, and the amount of leakage is a sure index of the quality of design and workmanship.

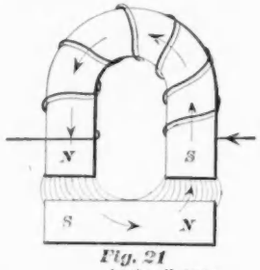


Fig. 21 American Machinist

INCREASED EFFICIENCY OF MAGNETIC CIRCUIT BY ARMATURE ADJACENT TO POLES.

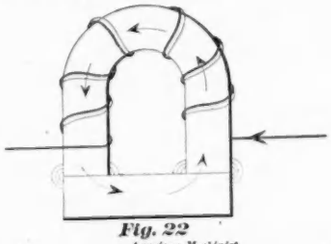


Fig. 22 American Machinist

INCREASED EFFICIENCY OF MAGNETIC CIRCUIT BY ARMATURE IN CONTACT WITH POLES.

Thus, a dynamo surrounded by a strong magnetic field—such, for instance, as will effect a watch at some distance—is a badly-designed and inefficient machine. That some of the dynamos in common use have this fault merely proves that a glib-tongued salesman often has more influence with our "shrewd" business men than quality of goods.

A ring of iron free from joints, perpendicular to the magnetic flux, constitutes the most perfect magnetic circuit, since it has no external field and no poles, Fig. 23. This last property may appear an extraordinary one to quote as of merit; yet a moment's thought will make it clear that the phenomena of poles is due to a rupture in the efficiency of the magnetic circuit. Hence, a perfect magnet will have no poles; the magnetic whirl about a single conductor has no poles.

But, it may be asked, of what use is a magnet without poles? The answer is, that of all machines for the conversion of energy, Faraday's transformer is one of the most efficient, and it comprises merely an iron ring and two coils of wire—Fig. 24; a primary coil which energizes the ring magnet, and a secondary coil in which the magnet induces a current of electricity. The relation between the current in the primary coil and that in the secondary coil is determined by the relative number of turns in the two coils; thus: If the primary coil has one hundred turns, and the current is one ampere at one hundred volts, equal to one hundred watts, and the secondary coil has ten turns; then the current in the secondary coil will be ten amperes at ten volts, equal to one hundred watts minus a slight inevitable loss due to the reluctance of the magnetic conducting medium.

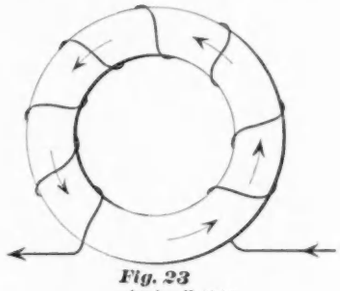


Fig. 23 American Machinist

A RING ELECTRO-MAGNET.

If the ring magnet above described be broken across, poles will at once manifest themselves. If broken in two parts, two magnets will apparently result. If broken again, four magnets will be in evidence. And so on to any number of pieces. Yet, after all, there is but one magnetic circuit and but one magnet. It is important to appreciate the fact that it is the magnetic circuit which really constitutes the magnet. This will be of great assistance in analyzing and classifying magnets.

17. PERMANENT MAGNETS. Thus far, contrary to custom, no description of permanent magnets, natural or artificial, has been given, simply because the electro-magnet is of such overshadowing importance. For the purpose of illustrating the flux of the magnetic lines, the conventional diagrams are here introduced. Fig.

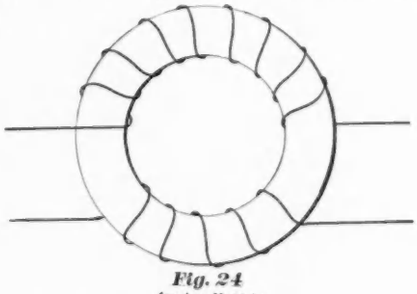


Fig. 24 American Machinist

A TRANSFORMER.

25 is a bar magnet. Fig. 26 is a horseshoe magnet. Fig. 27 is a cross-section of the magnetic field at one pole of a bar magnet. Fig. 28 shows the repulsion between similar adjacent poles. Fig. 29 shows the attraction between dissimilar adjacent poles. Fig. 30 is a magnet having "consequent" poles—that is to say, several poles existing in consequence of different portions of the bar being magnetized in opposite directions. Electromagnets of this type are of great commercial importance, and will be referred to again.

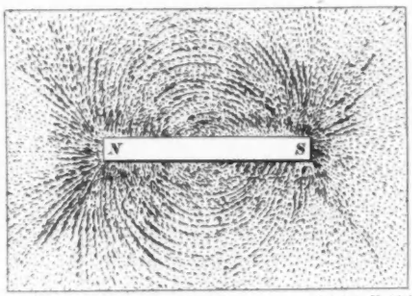


Fig. 25 American Machinist

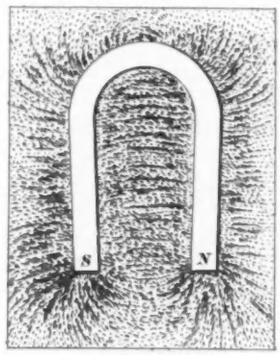


Fig. 26

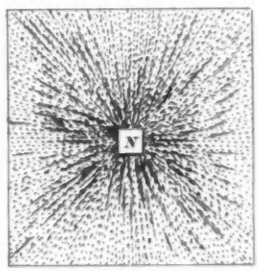


Fig. 27

PERMANENT MAGNET DIAGRAMS.

The student will find both instruction and amusement in the observation of these effects, which may be produced in the following manner: Place a sheet of paper over a magnet and sprinkle iron filings thereon, gently tapping the paper, when the filings will arrange themselves in the manner shown. By using gummed paper and afterwards steaming it, the filings may be fixed.

It was the observation and study of these lines which led Faraday to adopt the term "magnetic lines," and to the conclusion that the lines formed a closed or continuous path. As we have seen in the case of an electric conductor, the path may be a circle or may be distorted by attraction and repulsion, and will, in any event, follow the path of least resistance.

All permanent magnets are made from hardened steel. The lodestone is an iron ore of a composition represented by the chemical symbol, Fl_3O_4. This means that each molecule of the ore is composed of three atoms of iron and four atoms of oxygen. It is, therefore, like common iron rust, an oxide of iron, and is, in fact, identical with the black oxide scale on rolled iron. If the lodestone is suspended freely, it will place itself North and South. This fact led to the discovery of the compass, the lodestone itself having been used as such as early as the eleventh century. Hence the name, which means "leading stone."

That the earth is a great magnet was declared by Gilbert about the year 1600. Here arises a difficulty in magnetic terms. We have seen that the flux of the magnetic lines is assumed to be from South to North through the magnet, and from North to South through the field. Also, we have learned that opposite poles attract

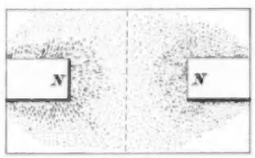


Fig. 28

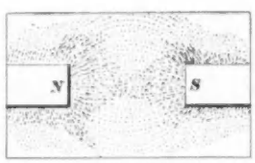


Fig. 29 American Machinist

REPULSION OF SIMILAR POLES AND ATTRACTION OF DISSIMILAR POLES.

and similar poles repel each other. Yet we find that the North pole of the earth attracts the North pole (commonly so termed) of a magnet—that is, similar poles here attract each other. This apparent contradiction is due to the fact that the so-called North pole of a compass needle is a misnomer, arising from early ignorance of the law of the magnetic circuit.

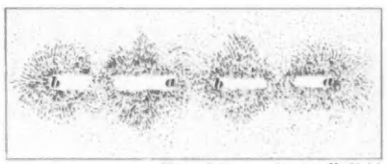


Fig. 30 American Machinist

CONSEQUENT POLES.

Indeed, science in her progress has brought many such a stumbling-block for those who seek to penetrate her mysteries. To avoid, in some degree, this difficulty, some writers refer to the poles of a magnet as "North-seeking" or "South-seeking." In these notes, for the same purpose, the terms "northern pole" and "southern pole" are preferred as being somewhat less clumsy.

Extension of Electric Driving at the Baldwin Locomotive Works.

Since the appearance of the article in our issue of June 6th, 1895, describing the electrically-driven wheel shop at the Baldwin Works, an extension of the system has been made to the frame shop, and it is now being still further extended.

The Baldwin Works now have outside the electric manufacturing shops, probably the largest plant of electrically-driven machine tools in this country, if not in the world. It may be safely assumed that these works do not follow after strange gods without good reason; and the growth of the system in such a place can only be taken as meaning that it has solid advantages over the system which it is replacing. The writer had, until recently, been quite skeptical on this subject, but is now disposed to conclude that the electric drive is on, and will probably stay on. Were the advantages of the system confined to what is held out as the chief one by the electrical promoters—saving in power—the writer's old-time skepticism would, however still hold. A saving of from 15 to 30 per cent. in power is found at the Baldwin Works; but were this its only advantage, the system would never have reached its present development, nor would further extensions be now contemplated. This saving in power is, of course, an item to be considered; but it is a bagatelle alongside of other advantages which cannot be expressed in figures, and which must be seen to be appreciated at their full value.

What has come to be a standard shop construction—a central bay for erecting, commanded by a traveling crane, and having a fringe of the heavier tools along each edge; with another bay each side, containing the smaller tools and the line

shafts—broke down, as an economical arrangement, when applied to the Baldwin wheel shop; for the reason that there is no erecting done in it, and all the floor space is required for tools or work. The shop being a ground floor shop, belt-driving from below is impossible; and with the tools driven by belts from above, the application of a traveling crane was impossible.

The result was the constant employment of from thirty to forty laborers, handling work on the floor and assisting in getting it into and out of the lathes. There was also a large amount of time lost with the lathes, due to the clumsy method of getting the work into and out of them—the average amount of idle time between jobs being about a half-hour, or from eight to ten per cent. of the entire time.

Furthermore, great care had to be taken to arrange the jobs to be done in proper sequence, as serious delays would happen if a pair of rough drivers wanted in the erecting shop this morning, should get placed behind so many others that they could not be gotten at for turning until to-morrow.

With the electric drive, all this is changed. The floor is literally filled with wheel lathes, while a traveler overhead serves them all without interference from belts or countershafts; the number of laborers employed has been cut down to eight or ten; the lost time between jobs does not exceed five minutes; and the wheels can be picked up as wanted, regardless of their order or arrangement.

The conditions in the frame shop were not very different. This is a three-bay shop; but having other floors above it, the bays are all of the same height, as they are also of about the same width. Here, as in the wheel shop, no room was required for erecting, and the central bay was the only one in which a crane could have been used—the side bays carrying the line shafts, and being, overhead, a wilderness of countershafts and belts. In point of fact, however, the use of a crane in the central bay, while possible, was not feasible; as, with a crane overhead, it would have been impossible to have occupied the center of the floor with tools. The consequence was that the only feasible system of hoisting or transporting machinery, was a network of overhead tram rails with chain hoists. The electric drive has solved the problem here, as with the wheel slip. The chain hoists and tram rails are no more, and the shop now has a Sellers traveler over each bay.

It will thus be seen that, so far, throughout the works the leading consideration in adopting the electric drive has been the facility it gave for using overhead cranes; although another important consideration is the independence which it secures for each tool from the works in general—any tool or number of tools being operated at night, if required, without operating any more of the shop than is actually at work. This, it is needless to say, has a great effect in cutting down the expense item connected with overtime work. All of the tools in both wheel and frame shops are, of course, of considerable size, and are driven by individual motors.

The next application of the system will be to sections of the works containing the smaller tools, where the crane feature does not enter. In that department, however, the individual motor will not be employed—each motor driving a section of line shaft, from which the tools will be driven in the usual way. The complete independence of each tool is thus lost; but in a works the size of these, it is seldom that any single small tool would be required for overtime work, and in any case the amount of idle shop driven would be small.

The significant fact connected with this extension is, that the degree of independence so secured is considered of sufficient importance to justify the introduction of the system.

LETTERS FROM PRACTICAL MEN.

"American Line" Practice.

Editor American Machinist:

Being out of work at present, and wishing to learn marine engineering, I went to the dock of the American Line in New York, and asked for a position as oiler. I was told to ask Mr. Patterson, aboard the steamer "Paris." I went to that gentleman, and he said he only shipped English lads for such positions, on the other side.

I wish to know whether they are better fitted than we are over here. I have served my time in a machine shop, and had five years' experience as stationary engineer, so I would have been able to do the work as well as any Englishman; but I think no American need apply on that line. I suppose they are afraid to give the American lads a chance, for they might beat them if given a show; so they would rather not risk that. But it is a poor showing for a company claiming to be American. If I had been told there was no place vacant, I would have been satisfied; but being told in such a way, I think it my duty to make it public.

CHARLES WINKLER.

716 S. 18th st., Newark, N. J.

Calipers, and Oil on Taps and Reamers.

Editor American Machinist:

Oh, no! Mr. Tecumseh Swift, the multiplying calipers don't exemplify the "non-survival of the unfittest" in the slightest degree, for two reasons—first, they survive; second, they are fit, not unfit.

But it is only fair to say that Mr. Swift and myself are not talking of exactly the same things; although the name we are both using accurately describes the things we each have in mind.

Multiplying calipers are greatly used, and are in the catalogs of small tool dealers; although, perhaps, not in the shops and catalogs with which Mr. Tecumseh Swift is familiar.

I do not think it is a good plan to talk too long and too much without pictures; and I have made arrangements with a man who goes about the country to furnish me with some pictures of multiplying calipers. Mr. Swift must bear in mind the fact that only a small part of the machinery built in this age is built in machine shops, and that a man may be quite familiar with some classes of machine building and quite unfamiliar with other classes. I find, as I travel through the shops with the "Eye Salve" and "Elbow Grease," that I can learn something most every day—and I'm not so very young, either.

But I do honestly and faithfully believe two things—first, that multiplying calipers should be used by every machinist, and on the work Mr. Tecumseh Swift is talking about, and that I shall be able to show some pictures of such calipers that will make that gentleman agree with me on this point; second, I believe it is a mistake to say one doesn't believe "Quirk" or any other man never saw what he says he saw, because one sees a lot of odd things here and there, and at one time and another, some of which are very curious. For instance, I once saw a big black bass using a big soft-shell turtle for a sun umbrella; I did, and I don't want any man to say he don't believe me when I say so; and maybe "Quirk" feels sensitive, too, when anyone says he don't believe what "Quirk" says. I don't know "Quirk"; I don't know who he is, even; but he may be notional about some things, for all that.

I am going to send Mr. H. E. S., of Pittsfield, Mass., a box of Jones' Patent Eye Salve, by mail; from his location, I think he needs it, or, at least, will find it of value to him, for I believe he has seen just exactly what I saw yesterday; and if his eyes had been real good, he would have seen too much to make him ask for any space in the "Machinist" for discussion of the tool-oiling question.

I don't know, after all, as I am quite right. What I saw—if I tell the truth about it, and I certainly mean to tell the truth—seems to clearly prove that the tool-oiling matter is both perfectly settled and perfectly unsettled.

The great trouble with the question which "H. E. S." has in his mind, is in the material he specifies. He says "in cast iron." I have lubricated cast-iron planer, lathe and mill cuts with soda-water, with very decided advantage. I have al-

ways thought a reamer cut was just exactly a mill cut; yet, I am perfectly certain that I should direct the use of a hand reamer in cast-iron, dry, and still use the same reamer in the latter, with the best oil obtainable. I know that, take, say, twenty little cast-iron gear hubs, and ream them with a Cleveland Twist Drill Company's ¾-inch expansion reamer, by hand, dry, they will all come extremely near the same size, if the reamer is in nice shape to begin with. That is on the "dry" side of the question. For a tap, I can only give one side of the story, as I always have all tap holes oiled inside before putting the tap at work in cast iron. I believe, of course, that the tap will do much better work with the oil in cast iron than without. I know of one case where there were a good many large holes to tap in cast iron—deep blind holes. It was very difficult and expensive to keep the holes to size, when the job came into my hands, using solid taps, dry. I made expansion taps and used them with lard oil, and never saw any sign of wear on the taps afterward. The threads were cut in the engine lathe, and the taps used for sizing—only cutting a very small chip.

The thing I saw yesterday, which made me feel as if there was no doubt about using the best lard oil for every possible cut in metal working, was a room containing forty metal workers, engaged in boring, turning, reaming and tapping metal work—a lot of extremely tame and obedient and diligent workers, these forty all doing exactly what the foreman put them to do, without any "back talk" at all, and working just as fast and just as slow as the foreman directed, with an exactly uniform time for each cut, and that time governed solely by the tool-edge endurance. The work was on tool steel, machine steel and brass rod; and was, in every case, brass and all, flooded with the very best lard oil. It is, perhaps, needless to say that these faithful workers were a lot of screw machines—Cleveland screw machines, to be precise.

I have often seen brass rod worked dry in automatic machines, and I made particular inquiry in regard to lard oil lubrication with wrought brass. This particular material was formerly worked on the same machines, dry. Experience shows a very decided gain in flooding the brass cuts with lard oil, same as all the other metal cuts. The foreman in charge of these machines thought taps in cast (or gray) iron should always be oiled with lard oil. All the same, the proprietor of the establishment, a thoroughly practical machinist of wide experience, thought holes in cast iron should be tapped dry.

I am firm in the belief that all cuts in metal, where the tool is rigidly held to its work, as is the case with a tap or reamer, should be flooded with lard oil. I am aware that lard oil is often "thinned" with kerosene for cutting-edge lubrication. I am also aware that this practice is not so common now as it was once. I am also aware that on two screw machines, standing next each other, and with seemingly the same cutting-edge work, not on the same piece, the one tool was using lard oil and soda-water, while the other was using lard oil only; and the foreman in charge could give no better reason for the lard oil and soda-water variation, than that the cut had always been so lubricated and gave no trouble.

All of this don't help the gray-iron cutting-tool lubrication question so very much; and perhaps Mr. H. E. S. don't need the Eye Salve any more than I do, and I needn't be in any great hurry to send it to him.

It seemed to me yesterday that those forty machines, on all kinds of stock except cast iron, all flooded with lard oil. should really settle the question of cutting-tool lubrication. It isn't much use for hand workers or "machinists" to try to settle such a question; they don't have cuts enough to make. The only sure way to settle it seems to be to take a lot of, say, 10,000 gray-iron pieces, and put them through the automatic machines without lubrication in tapping and reaming, and keep track of the tool-making expenses; then take another lot, of the same number and same stock, and use a flooded lard-oil lubrication—and compare cost sheets.

Any metal-cut lubrication short of a big running stream—flooded lubrication—proves nothing at all; as a cut not actually submerged in the lubricating material may seem to be lubricated, when the actual cut is made dry, and the only effect of the lubricant is to grease the outside of the chip.

While I may be wrong— and, if so, I am thankful for it, since I would not be unlike my fellow-men—I feel confident that gray iron is no exception to the rule, and that, under a test of convincing quantity factor, it will be found to be the better worked with flooded lard-oil lubrication.

EASY WAY.

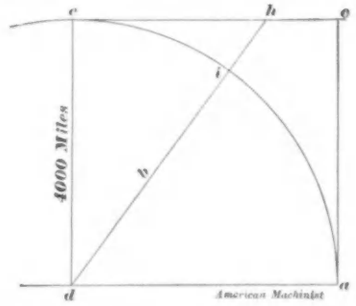
The Curvature of the Earth.

Editor American Machinist:

I have always refrained as much as possible from copying the designs of others, when planning anything new in the machine line, and experience has shown me more than once that such a course is sometimes questionable. When it comes to selecting a second-hand subject with which to interest your readers, I have much of the same feeling. Yet there can be no doubt but that a good borrowed subject may be better than a poor original one.

Although I have not had the pleasure of knowing your esteemed and versatile contributor, Tecumseh Swift, yet I will venture to offer a thought or two on his subject, "A Little Dangerous Knowledge," as presented in the "American Machinist" of December 5th. One reason why I have been profoundly impressed with this subject is, that since becoming aware of the fact that my little store of knowledge is very limited, the old adage, "A little knowledge is a dangerous thing," seems to apply especially to the class to which I belong. Being, therefore, in sympathy with the ignorant is a sufficient excuse, perhaps, for my inclination to apologize for the author of the leveling story, who says that "the earth curves eight inches to the mile." To do this, all that is necessary is to change the article "the" into the adjective "a" in the above quotation. But even by taking the mistake at its worst, it becomes so glaring that it can hardly be regarded as a dangerous one.

It is unaccountably strange that, while taking the author of this mistake to task, a critic like Tecumseh Swift should have committed a more serious blunder. I am



sure he would not have done so had he taken a little time to think. I refer to the statement which says, "The curvature is very nearly eight inches for one mile and the curvature for any other distance is just as the square of the distance." The diagram accompanying the article is a little confusing, too, in that the distances showing the curvature are represented by right angles to the tangent, in place of a radial line from the center of the earth. This would complete the right angle triangle from which the calculations are made.

By applying the formula given above, we have the following:

$4{,}000^2 \times .666 = 10{,}666{,}666$ feet, or 2,020 miles, for the distance from a to c, Fig. 1, which is known to be 4,000 miles. It is clear that 8 inches, or, more accurately, 7.92 inches, is the curvature in one mile, but this, it seems, bears no fixed relation to the square of other distances, not even when the secant b of the right angle is measured. By assuming that the distance from d to e is 4,000 miles, and that from e to h is 3,000, it is apparent that h and i will be 1,000 miles apart. Now, by the formula, as before: $3{,}000^2 \times .666 = 5{,}994{,}000$ feet, or 714,000 feet more than is contained in the true distance of 1,000 miles; so that, whichever way we figure the formula, it is far from correct.

The leveling incident illustrates important facts, which are no doubt of interest

to many whose attention has never been directed to these things before. Practically there can be no perceptible difference in a line of shafting, as ordinarily employed, whether leveled by the surveyor's instrument or the ordinary spirit level. The first is, of course, the most expeditious, when the surroundings admit of its use. If, however, there is a variation of one-half an inch in a distance of 1,300 feet, and if such a length is admissible, then the true level is undoubtedly the best.

In conclusion, it may be said that many of the dangers which beset those in quest of useful knowledge, as well as those imparting it, may be avoided by maintaining a level head. QUIRK.

The Gates Drawing Room—Filing Tracings.

Editor American Machinist:

Do you know how and where Mr. Randol was entertained the night before he made his study of the Gates Iron Works drawing room?

He has turned out a very interesting leading article for your issue of January 16th, and I hereby subscribe heartily to its closing paragraph. I wish, however, to describe a few reflections induced by another paragraph, concerning the "inspiration" about filing tracings, which, it seems to me, must have been an inspiration something like Rip Van Winkle's, as a result of his falling in with Hendrick Hudson's bowling team.

I have wrestled with a good many provoking things: I have done the Pigs in Clover and the Fifteen Puzzle; learned to ride a bicycle all alone, and, riding, got caught in a heavy rain twenty miles from home and many miles from anywhere; but none of these things are in it for a minute to a man with only two hands, when compared to a roll of disconnected tracings. Think of having every individual tracing in a shop rolled up tight every time you want to look at it! I do not believe Mr. Randol heard what the draftsman said when his paper-weights slipped, and the tracing worked the fly-trap act and rolled off over the edge of the board, nor the remark of the blueprinter when he put one in the frame. I should think a tracing that was wanted often enough to get "dog-eared" being handled in a flat drawer, would get to need the Gates office benzine cleansing process as a regular thing when subjected to the roll-and-tube storage plan.

Then the incredibly small space occupied. Did you ever fill a pail with pebbles, and measure the water the pail would hold both with the pebbles in and with them out? There is a lot of space between the pebbles and between the paper tubes.

Now I keep a lot of drawings, some tracings, in a vault, on thin shelves, in paper portfolios or covers—drawings of one machine or one subject in a convenient number to handle by themselves. I do not know how many there are there, but if Mr. Randol will give us some figures covering the number of tracings stored in a given space in tubes, I will have mine counted and reported; and if I do not beat the tube plan, I will apologize to Mr. Randol and furnish him entertainment for one more night if he will come to Worcester.

WM. L. CHASE,
Knowles Loom Works, Worcester, Mass.

Manufacturing by Wholesale and by Retail.

Editor American Machinist:

Any machine shop engaged in making engines, printing presses, milling machines, or any other class of work on which there are small pieces which involve a great amount of labor on a comparatively small amount of material, should make these smaller pieces in quantities and carry them in stock. Most shops make the mistake of making the exact number of each of the small parts required for a certain order of machines only, notwithstanding the fact that a month after another lot of the same machines will be again finished.

In a certain Chicago shop, where Corliss and slide-valve engines are built on orders only, they make no pretense of carrying engines in stock, yet they make the smaller details of valve gears by the hundred pieces, thereby being able to make excellent use of those money-savers, special tools, which reduce the cost of these small parts to the lowest possible figure, besides enabling them to make prompt shipments.

There was a time when every machine shop hammered out on the anvil, turned and threaded in the lathe, every stud, bolt and screw used in the shop. But no modern shop can do it and stay in the procession. What is true of bolts, screws and studs is also true of other small machine parts—they must be made in quantities and carried in stock. Let any shop today undertake to build a common, small slide-valve engine—I mean the shop which occasionally builds such an engine—making the screws, bolts, etc., and that shop won't get as much profit out of it as the manufacturer from whom they buy their oil cups.

Seventy years ago, a shoemaker could make shoes complete, including the making of the wooden pegs by hand, and support a family. How is it to-day? The man who, by special machinery, makes only the wooden pegs gets a better living, more leisure and luxuries than the old shoemaker ever dreamed of. I personally know of a case where a boy, working for fifty cents a day, earned for the shop one dollar an hour, simply drilling ⅛-inch holes through small brass ferrules, similar to those on a file handle; and of another case where a large shop had some thousands of pieces which they could not machine in their own shop for less than twenty-five cents each, so let them out at eighteen cents each to a little one-horse shop run by two young fellows. Those fellows spent about five dollars in fixing up for the job, and turned sixty-five of those pieces each per day, as long as the work lasted—and it was only lathe work after all. They worked pretty hard; but there are quite a number of machinists who would be willing to work hard for $11.70 per day. This all points to the fact that, in order to get money out of the shop, the work must be divided into specialties, and finished in quantities, by special tools, or by special men. You can't have a man run a lathe to-day, a planer to-morrow, and a milling machine next day, and get any money out of your shops.

Seventy years ago, my grandfather was working as a carpenter, building houses. I have seen the planes he used to plane sticks with, by hand, for window sash. Go into a hardware store to-day, and ask a young clerk to show you a sash plane, and ten chances to one he wouldn't know what you were talking about.

There isn't a piece of a modern house which isn't drawn from stock and assembled. The idea of building anything piece-by-piece for each individual case, is fast going out of date; and in the case of house carpenters, is so far out of date that even their tools have become relics of prehistoric times.

Speaking of engine building, I have in mind another shop where they make complete, and carry in stock, a hundred governors, and they make the smaller parts of these governors by the thousand pieces—which means, when compared with the cost of making them piece-by-piece for individual engines, that they practically get them for nothing.

W. H. CHAPPELL.

Harvey, Ill.

Some Time-Savers.

Editor American Machinist:

The following may interest some of your machinist readers:

As Messrs. Brown & Sharpe Co. are mailing a copy of their new pocket catalogue to any one for the asking, and as nearly every machinist has an old copy, as I have. I removed the pages of "Table of Decimal Equivalents," and also "Table of Decimal Equivalents of Millimeters and Fractions of Millimeters," and mounted same on opposite sides of a thin piece of hard wood, with glue, and then gave the whole two coats of colorless shellac. In the top end I put a suitable hole, to hang the board up by. These tables are very handy for daily use, as most shops are called upon to use both systems of measurement.

In setting over the tail stock for tapers, it is hard on the ordinary lathe to replace same so it will be in line with live center. By placing a 2-inch piece of steel rule on a little bracket at back end so it will lie horizontally on bottom part of rest, and a small pointer on the set-over part, and having said pointer so it will be on the center line of rule when the tail center is in line with the live center, it is a very easy matter to replace the tail center in line. And by having the face of rule horizontal and at back end of tail stock, it is easily seen and away from chips and dirt.

I wish to ask if electric process of welding has given the results claimed for it a few years ago. I do not see anything in the journals about it. I have noticed that all the bicycle builders braze their work, instead of using the electric welding process.

F. H. JACKSON.

Angelica, N. Y.

Case-Hardening.

Editor American Machinist:

I notice in your December 12th issue a request for some case-hardening processes. Having had considerable experience in such work, perhaps my methods may assist others. First procure a cast-iron crucible, or, if that is not obtainable, make one out of a piece of steam pipe. It is best not to be less than 4 inches in diameter. If pipe is used, weld a disk in one end, and make the cover to fit fairly well. Then get some bone char, and if that cannot be got, burn some bones in a slow fire, being careful to exclude the air while burning and until cold. Then powder about as fine as sand; also powder some hardwood charcoal. Now put a very thin layer of powdered bone char and charcoal in bottom of crucible, then a layer of pieces to be case-hardened, and so on until filled so that cover will go in flush with the top of crucible. Then seal it with fire-clay, and heat slowly to a bright cherry red. Care must be taken to have a nice even heat all through. Remove crucible or pot from the fire, and as quickly as possible take the cover off and pour contents in clean cold water. It is better to have a perforated pan in the bottom of water tub, as then the char can be all riddled out, leaving the hardened pieces clean. They can then either be dried in a hot lime bath or over the fire. Then sprinkle a little kerosene oil over the pieces, to prevent rusting.

If only one or two pieces are to be case-hardened, a very good way is to heat slowly to bright cherry red and put powdered yellow prussiate of potash on, letting pieces become black hot before putting again in the fire; then reheat as before and quench as quickly as possible. Should this not produce a hardened skin of sufficient thickness, repeat the heating and potash operations before cooling. The first heating will produce a hardened layer of about 1-16 inch, and to repeat will give about double, or ⅛ inch.

I have used this last method for hardening very thin irregular and circular punches and dies made from "Black Diamond" tool steel, for some years, quenching in oil instead of water, with perfect success, having never lost a piece so treated. Pieces so treated will be found to retain their shape and size very closely. If it is necessary to draw pieces hardened in this way, care must be taken not to draw too low. Light straw color is about the same degree of hardness as purple, on pieces quenched in water.

CANADA.

The Kane-Pennington and Other Oil Engines.

Editor American Machinist:

In Mr. Randol's account of the Kane-Pennington motor he makes the statement that "the motor was suspended by ropes and run for hours at a speed of 1,500 revolutions per minute, and at times perhaps more." I am inclined to think that if he had used a speed indicator this statement would not have been made, as a speed of 1,500 revolutions would require fifty sparks per second, as there are two sparks made for each revolution with this style igniter, saying nothing whatever of the enormous piston speed. When the piston carries one of the electrodes there are necessarily two sparks made per revolution, as the first spark must be made before the piston reaches the end of the inward stroke. Then the electrodes will spark again as they pass on the outward stroke, this last spark being entirely useless, except to shorten the life of the batteries; but it cannot be eliminated unless the spark is made just as the piston starts on its outward stroke, which is too late to gain the best results. As this engine is of the four-cycle type, there are four sparks made and only one used. The indicator cards are probably of the most importance, as they show what really takes place in the cylinder. They show a higher compression than is customary with most builders. The usual compression is from 30 to 40 pounds per square inch, with a preference for 35 pounds. Pennington uses 60 to 65 pounds. Then the initial pressure does not appear to be as great as would be expected from such a compression, as it is only 170 pounds per inch; whilst in engines using only 35 pounds compression, the initial pressure is from 200 to 220 pounds per inch. It will also be seen from the cards that the exhaust ports are smaller than of other makes; for instead of the expansion line dropping to the atmospheric line at the end of the stroke, it does not reach the atmospheric line until the next outward stroke is partially made, thus preventing the engine from taking a full charge of fresh mixture. Card No. 5 is the best one of the whole lot, as the compression is not so great, and the expansion line drops to the atmospheric line at the end of the stroke. Cards Nos. 6 and 7 illustrate the explosions that are made by a late spark to start the engine. This spark is made during the outward stroke to prevent the engine from going backwards. Most builders have a device of some kind for making this late spark; it prevents strained wrists, and as soon as the engine attains its speed the spark is then changed to its normal position. So, with the exception of the reduction of weight, the Kane-Pennington motor cannot be regarded as marvelous. This has not been written for the sake of fault-finding, but to contrast the engine with other makes of probable equal merit, as far as efficiency goes.

IRVING LONGENECKER.

Dayton, O.

Algebraic Formulas.

One of our readers writes us a letter, indicating that he has been confused by the absence of multiplication signs in the formulas which have appeared in Mr. Mason's articles on "Electrotechnics," while these signs have appeared in the numerical examples which have been given in illustration of the use of the formulas.

It should be understood that the multiplication sign is usually omitted in formulas between letters which are to be multiplied together. Thus if a represent one quantity and b another, $a\ b$ in a formula is the same as and may be read $a \times b$.

The sign is not omitted in the case of arithmetical examples, since the different quantities would then have nothing to indicate the division point. Thus, for $a \times b$ we may write $a\ b$ without confusion; but if the multiplication sign were to be omitted in such an expression as 7×9 we would have 79, seventy-nine, not seven multiplied by nine.

This whole subject of algebra is an unnecessary bugbear to many practical men. Algebra, as actually used, is practically a shorthand arithmetic, an algebraic formula being simply an arithmetical rule expressed in signs and symbols, instead of descriptive names. It is not a difficult subject to master, and, when learned, its great advantages are at once apparent. We have no sympathy whatever with unnecessary or prolix mathematics, whether expressed in arithmetic or algebra; but the use of algebraic expressions or formulas in place of arithmetical rules is not a case of this kind. On the other hand, the formulas are plainer and easier of comprehension than the rules which they replace; and their use by another is not to be laid to a desire to display his learning, but to the fact that the formulas are the plainest and most direct statement of the

rule. Algebra is, in fact, primarily used for complicated work, because for such work arithmetical rules break down. When a rule becomes so long and involved that the mind can hardly take it in as a whole, algebra steps in, and, instead of a rule occupying perhaps a paragraph of print, gives in one line an expression in letters and signs which the eye and mind can take in at a glance.

We expect to publish soon an article on this subject, which will make plain to anyone who will use a little effort, how formulas are to be read and used.

An Oil Swindle Exposed.

Here follows the story of an oil-swindling game, which our friends will do well to look out for.

For some time past, machine-shop owners and other consumers of oil have been receiving (usually from Cleveland, O.,) offers of small lots of lard oil, at special low prices.

The impression sought to be made in each case is that the oil is offered at a specially low price (below the regular market price of lard oil), simply because a particular small lot of oil is, for some special reason, on hand near the prospective victim, and the trouble and expense of shipping it back to Cleveland is sought to be avoided.

Several of our friends have been caught by this game, and have received oil represented to be pure lard oil, yet containing really very little lard oil, and worth much less than the low price asked for it. Until recently we have not been able to get definite facts regarding any specific case sufficient to warrant publication; but we now have them, and give herewith a reduced fac-simile of such a proposition, with an authoritative analysis of the oil delivered on the acceptance of the proposition.

This proposition from the Valley Oil Co., was received by the Tuttle & Bailey Mfg. Co. soon after the appearance in our columns of a letter from Mr. Geo. B. Grant, referring to such swindling, but mentioning no names. Messrs. Tuttle & Bailey promptly mailed this proposition to us, and we requested them to accept it and notify us of the delivery of the oil.

When delivered at Tuttle & Bailey's shops (where they make warm-air registers, ventilators, etc.), some of the oil was delivered to us and put in the hands of Durand Woodman, of this city, for analysis. Mr. Woodman certifies that the mixture contains:

Mineral oil	72.25%
Lard oil	27.75%
	100.00%

Thus the oil designated in the proposition and in the bill subsequently received for it, as "Ex. No. 1 Lard Oil," is really only a little over one-fourth lard oil, and the rest is mineral oil; and instead of 38 cents per gallon being a low price for it, it is a high price.

That this is a case of deliberate swindling is further shown by the fact that the oil was not delivered to Tuttle & Bailey from a near-by point—as, for instance, Brooklyn, New York or Jersey City—but was shipped from Cleveland to Tuttle & Bailey in the usual way, as documents in our possession show.

Acting under our advice, payment for the oil was deferred, until, finally, on the 8th of January, the Valley Oil Co. drew on Tuttle & Bailey, and the bill was paid, the following letter accompanying the check:

Brooklyn, N. Y., January 9, 1896.

Valley Oil Co., Cleveland, O.:

Gentlemen—Please find inclosed the bill for oil and check paying the same. The oil was not at all as represented, as it contained but a small portion of lard oil and was inferior in every way. The only reason for paying this bill is that the barrel began to leak over our floor shortly after its receipt, and our man emptied it into our tank without examination. We have used a portion of it, and cannot conveniently return it without more trouble than the bill amounts to.

Under other circumstances, we would have promptly returned the stuff.

Yours,

TUTTLE & BAILEY MFG. CO.
Silas Tuttle.

Being in the business, we may perhaps as well add a reduced fac-simile of a proposition received by Geo. B. Grant, also

OFFICE OF
VALLEY LARD OIL CO.
121 SUPERIOR ST.

Cleveland, O., Oct 11. 1895

Tuttle & Bailey Mfg Co
Brooklyn N Y.
Gentlemen
Can you use 1/2 Bbl.
Ex No 1 Lard Oil we have at your place and do not want to freight back. The oil we warrant excellent Lard nice and the price we will make 38¢ per gall
For this favor we will kindly thank you and it will be highly appreciated
Please answer and oblige.
Yours Respy
Valley Lard Oil Co.

You need not pay for it unless satisfactory on examination.

from a Cleveland concern. It is noticeable that neither of these letters has the name of any individual either printed upon or signed to it; and, if one should stop to consider the matter, neither of them would inspire much confidence in the genuineness of the proposition made.

THE SUPERIOR OIL CO.
MANUFACTURERS OF
High Grade Lubricating Oils.

CLEVELAND, O. Sept. 18, 1895

M Geo. B. Grant,

Lexington, Mass.

Dear Sir-We have at our distributing point near you, a couple of half barrels of oil which we would like very much to dispose of and will do so at very low prices. There is in the lot:

1/2 Bbl. Superior Cylinder Oil, 27c. per gal.
1/2 Bbl. Superb Engine Oil, 23c. per gal.

If you can use either one or both of the packages, we will make you the above prices delivered, no charge for package. The quality of these oils we guarantee to be equal to any in the market, and subject to your thorough test and examination.

Hoping to hear from you favorably, by return mail, we remain, with best wishes,

Yours very truly,

The Superior Oil Co.

The New York Cycle Show.

The cycle show at Madison Square Garden, in this city, last week, was a much larger and more comprehensive exhibition than those previously held here. Not only was the vast main floor of the amphitheater fully occupied, but three tiers of galleries all around the vast edifice were also crowded with the exhibits. The exhibition was also rigidly confined to its specific purpose of displaying cycles, their details and appurtenances, to the exclusion of everything else. Unfortunately for us, the appurtenances did not seem to include the tools and machinery so necessary in bicycle production. In all the vast space occupied, as enumerated above, for the exhibition of bicycles, the only thing that we could discover in the shape of tools and machinery was a working model of a Billings & Spencer drop hammer, which was shown in a little coop in the second gallery, the coop or bin aforesaid being mostly occupied with a fine display of bicycle drop forgings made by this firm, so familiar to our readers. But in addition to the space above mentioned, a sign on each side of the hall allured the inquisitive visitor to a so-called "Machinery Hall." The machinery hall proved to be a couple of dingy corridors extending under one-half of the first gallery on each side; and in only one of these was any machinery to be found, the other one having been appropriated, like all the rest of the space, by the bicycles and things directly pertaining to their use and users. In the one miserable corridor we found two presses, exhibited by the Ferracute Machine Co.; one four-spindle drill, by the Pratt & Whitney Co.; a hub-turning turret lathe, a universal milling machine, a little upright drill and a small lathe, by J. J. McCabe, of this city; and by the Fox Machine Co., of Grand Rapids, Mich., their excellent bicycle-rim drilling machine, which has been improved since it was described in our columns, by the addition of a good universal chuck, the jaws of which are all moved in and out by a screw movement operated by a central gear; a pipe or tube cutting off machine, a universal vise for bicycle shops, and a ball-cup press. That was all in the line of tools or machinery for bicycle manufacture that could be discovered. It is understood that the manufacturers of this class of machinery are so full of orders that they did not care to exhibit, even if they could have secured the space.

The show, as a whole, in its details, some of them very minute, appeals strongly to the mechanic. Each wheel has its special features, of more or less, and of real or imaginary, importance; and to understand them all, and the explanations of them all, would imply a liberal and comprehensive mechanical education. The bicycle business is getting down to a business basis. The exhibits of all the principal makers, and of probably a majority of all the cycle exhibitors, include the various parts of the wheels in different stages of manufacture; and in these, if time would allow, the methods of construction might be studied.

The most important material in bicycle construction is, of course, the steel tubing, and next to that in importance probably comes the drop forging. The tubing of to-day certainly surpasses even the imagination of the constructor of a generation ago; but we may expect to see it still more improved in the line of taper work, and in the continuation of the single tube, without brazing, into the bends and angles involved in the construction. Some exhibitors show frames composed entirely of steel tubing—knuckles or joints and all—but, unfortunately, not without brazing. The endless variety of shapes in which the drop forgings now appear suggest the foundry rather than the blacksmith shop; and the making of dies for them is really a new pattern-making trade.

Various devices for changing the gear of bicycles are exhibited. Several modes of adjusting the chain tension are also shown; a compound lever, giving the treadle a quick return and a slow tread, is exhibited. Various application of the cycle to military uses are also to be seen. Two or three machines are mounted with quick-firing guns; and a tandem bicycle, with rifles, blankets, knapsack, etc., strapped to it, looks decidedly warlike. The motocycle is conspicuous by its absence.

The show is a wonderful exhibition, and appeals to all civilized humanity, both male and female.

A correspondent sends us an account of a bridge failure. The deputy coroner, in discussing the matter, is reported to have said that though the bridge was supposed to have been made of wrought iron, yet parts of it had broken short off, and in this connection he remarked that "wrought iron will bend, but not break."

By this we suppose this deputy coroner came to the conclusion that the bridge was not made of wrought iron, the fact that it broke being by him regarded as evidence to that effect. Most of us have an idea that wrought iron will break, sometimes.

The recent adventure of the steamer "Strathnevis" in the Pacific is a strong argument for twin screws. She left Tacoma for Yokohama on October 12th, with 2,000 tons of freight and 125 passengers. When half-way across the Pacific, her single shaft broke, and, having little sail power, she drifted helplessly for two months, when she was sighted and finally towed to Port Townsend, a few miles from her starting-point, arriving there December 12th.

Explosion of Acetylene Gas.

On January 21st, at New Haven, Conn., an explosion of a tank of liquefied acetylene gas, and subsequently the explosion of a second tank, with the fire that ensued, completely destroyed a building and caused the death of three men. It is understood that some experiments were in progress upon a regulator for controlling the delivery of the gas for service.

AMERICAN MACHINIST

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BY THE

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FRANK RICHARDS, F. A. HALSEY,
Associate Editors.

Special Announcements.

☞ *We publish nothing in our reading columns for pay, or in consideration of advertising patronage. Space in the advertising pages only is for sale.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Every correspondent, in order to secure attention, must give his full name and address; not necessarily for publication, but as a guarantee of good faith.*

☞ *All communications for or relating to the reading columns should be addressed to the editor. All other communications to the company, as above.*

☞ *Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

☞ *The* ***American Machinist*** *is not interested in any particular patents, products or factories, to the prejudice of others, but is devoted to the interests of all those who have to do with designing, building, selling and using machinery.*

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$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.
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Special Club Rates. Write to us for particulars.

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E. CHENEAU, 246 Rue de Normandie.

Some complaints reach us regarding the present manner of mailing the "American Machinist," and some of our friends think it would be better to fold it once down through the middle. Perhaps it would in some respects be better this way; but, on the whole, we think the present plan the best one.

We have recently made the discovery, however, that publishers who roll their papers for mailing, usually roll them wrong side out; and it may be noticed that our paper has been reversed this week, so that when the wrapper is removed and the paper rolled the reverse way a little, its own weight will tend to make it lie flat when laid down right side up.

As soon as our large order can be filled by the manufacturers, we shall use a patented wrapper, which completely avoids all difficulty in removing the wrapper from a rolled paper.

Owing to a principle familiar to mechanics, a rolled paper is much stiffer and less liable to be broken in the mail than when folded flat. We have no prejudice in favor of any particular manner of folding, but have simply adopted what we consider the best, all things considered, and in the light of experience. We predict that when our new wrapper comes into use, little or no trouble will be experienced in handling the paper.

An exhibition of what Keeley calls his "polar-depolar sympathetic force," or the "interchange of polar and depolar sympathy," has led to the inquiry whether Mr. Keeley is not or will not soon become a spiritualistic medium. He says: "I am always a good deal disturbed when I begin one of these exhibitions; for sometimes, if an unsympathetic person is present, the machine will not work."

This certainly sounds very much like the talk of the spiritualistic medium; and it is evident from it that, if Keeley's engine is ever to come into use, engineers must possess a new quality not now usually possessed by them—that is, they must be in sympathy with "polar-depolar" forces.

It is quite noticeable that bicycles of this year's models are better adapted for the everyday uses of those who ride for pleasure and business than formerly, and that there is some tendency to discontinue the practice of sacrificing everything else to the notions of the comparatively few racing men. This is a step in the right direction, of course; and a further step in the same direction would be to entirely abolish the notion of having '95, '96 and '97 "models," and make improvements and changes as needed, the same as carriage builders and engine or machine tool shops do.

It seems to be now pretty well settled that a combination agreement has been reached, by which the output of iron ore from the Mesaba range will be controlled, and its price kept to about the competitive price of iron ore which has to be mined by the usual laborious and expensive methods, instead of being simply shoveled on to cars by steam shovels, as the Mesaba ore is. Thus, this arrangement of Nature, by which mankind might derive the benefit of cheap raw material for one of our most important products, is made to benefit a few monopolists only.

Americans in the Engineer Force of the "American Line."

In another part of this issue we publish a letter from an American citizen who states that he was refused a chance to serve in a subordinate position in the engineer force of the steamer "Paris," of the American line, solely because he is an American instead of being an Englishman.

It will be remembered that, a few years ago, there was considerable blowing of trumpets about the admission of the steamers "Paris" and "New York," of the Inman Line, to American registry. This was a concession made to the owners in consideration of their having two similar vessels built here (the "St. Paul" and "St. Louis"), all four of the vessels to be a part of the naval reserve—i. e., officered by American citizens, and liable to be called upon for naval service if needed.

In compliance with the letter of the law under which this transfer was made, the captains, mates, etc., of the "Paris" and "New York" have declared their intention of becoming citizens; but those interested prevailed upon Mr. Foster, who was then Secretary of the Navy, to decide that the engineers of a steamship were not officers, and in this way the plain intent of the law was evaded, so far as the engineer department of the ships named is concerned.

It was represented at the time that no Americans could be found who were capable of managing the engines of such vessels; and the letter referred to shows that, so far as it is possible to prevent it, no American shall have an opportunity of learning how to do it.

The pretense that the engineers of a steamship are not officers of it, is, of course, absurd; but it is no more absurd than will be the position of the present Congress if it shall refuse to enact such laws as will insure that every vessel forming part of our naval reserve shall have its engineer department in charge of American citizens.

The American Line draws an immense subsidy from the United States Government, and should be made to toe the line when the plain rights of American citizens are concerned.

Especially should it not be allowed to

practically insult and degrade worthy men belonging to an honorable and highly responsible profession, by maintaining that the men who direct much the most important work done on board a modern steamship, and requiring the largest force of men to do it, are not officers, but only part of the crew.

Senator Squire, whose good work in behalf of the engineer corps, and the best interest of the navy in general, we have before referred to, has introduced a bill, part of which reads: "And all the officers of vessels of the United States shall in all cases be citizens of the United States. The word officers shall include the chief engineer and assistant engineers on vessels propelled wholly or in part by steam, and no person shall be qualified to become an officer of a merchant vessel of the United States who is not a native-born citizen, or whose naturalization as a citizen shall not have been fully completed."

In introducing this bill, Senator Squire said, among other things:

"If the steamship companies which are getting subsidies from the Government do not consider their engineers officers, I want Congress to make them officers in the eyes of the law, so that in case of trouble with any country requiring the services of these steamers to supplement those of the navy, we shall have them all ready with their officers and crew, as the act contemplated, and not as they now are, officered in their engine rooms by foreigners. Another thing which I want to see enacted into law is, that these men shall be bona fide American citizens, and not merely men who have taken out their first papers, and have no intention of going further in that direction.

"I believe that wherever and under whatever circumstances Americans have served, they have acquitted themselves most creditably, and I cannot believe that the engine rooms of these big steamers are such mysterious places that the American marine engineer would be a stranger there.

"Our American engineers are serving creditably on vessels engaged in Oriental commerce and along the shores of Asia. I claim that they are equal to the Scotch or any other engineers. They get the best pay and perform as good service as any. Our country can depend upon them in its commerce in time of peace, and can depend upon them, if need be, in time of war."

Most American citizens will, we think, agree with these sentiments, and also that the present condition of affairs is an outrage and a disgrace which should be wiped out, and the sooner the better.

A portion of Mr. Winkler's wages, when he is so fortunate as to be earning wages, is absorbed by taxes of various forms that are applied to paying an enormous subsidy to this "American Line," which, while seeking to, and actually enjoying this and other advantages of American registry, is, it seems, American only in name. It should be made to become American in fact, or put back where it was originally, and where it evidently now belongs—i. e., under the British Government.

Death of an Engineer and Inventor.

Charles W. Hewison died in this city on January 19th. Mr. Hewison was educated as a mechanical engineer, and when but nineteen was one of the thousands, who, in 1849, flocked to California, under the first attack of the gold fever, making the trip by way of Panama. Soon after his arrival he secured employment on a Pacific mail steamer, becoming chief engineer. Just before the war Mr. Hewison returned to New York, and was associated with Ericsson in building the "Monitor." He became the proprietor of a large brass foundry and finishing shop, and here built the first phonograph for Edison, and many models used by Ericsson in his later work. Several inventions of his own also were applied to marine engines.

Questions and Answers.

Name and address of writer must accompany every question.

Questions must pertain to our specialties and must be of general interest.

We cannot undertake to answer questions by mail.

(21) J. F. P., Massillon, O., writes: It is rumored that the Japanese are manufacturing bicycles and importing them into this country. Could you state if this is true; and, if so, who their agents in the United States are? A.—We have heard only rumors regarding this matter, and do not believe such wheels are being sold here, and doubt if any great numbers are being made in Japan.

(22) C. M., Birmingham, Ala., sends us a sketch of a gear tooth 12 inches long, 4-inch pitch, and with a shrouding web 1 inch thick extending to the pitch line. The gear has 91 teeth, is 115⅞ inches diameter, and runs at 26 revolutions per minute. Our correspondent says: "This gear, according to a table and rule given in the 'American Machinist,' August 15th, 1895, will transmit 184 horse-power without shrouding allowing a stress of 2,000 pounds per square inch. How can I compute the additional strength gained by shrouding the gear as shown?" A.—We are not aware of any formula that is of much value in this case. It would probably be safe to assume that the shrouding adds from 10 to 15 per cent. to the strength of the gear. The shrouding is rather thin for the pitch.

(23) A. M. H., Worcester, Mass., asks: 1. Is there any substance known that will prevent brass from adhering to steel when both are heated, as in brazing? I want to get a good, clean joint. A.—Lampblack will effectually prevent the metals from adhering. The surface may be blackened by the flame of a lamp or candle, and care should be taken to avoid rubbing it off. 2. How would you get the correct diameter of a circle inclosing a stated number of balls, as in a ball case for a bicycle? A.—We would be quite likely to do it graphically, as here shown. The number of balls would determine the angle or the portion of the circle occupied by each. Say that the number of balls is 18; then each ball will require 20 degrees. Draw a circle representing one of the balls; and if the balls are small, it may be drawn much larger than the actual size. Draw the two lines *A B* and *A C*, each tangent to

the circle, and forming at *A* an angle of 20 degrees. Bisect the angle by the line *A D E*. Then *A E* will be the radius of the required inclosing circle, and *A D* will be the radius of a circle which the balls will inclose—both, of course, upon the same scale as the first circle.

(24) W. H. B., Lawrence, Mass., asks: With a lead screw of 5 threads to the inch, how can I cut 4 threads to 1 1-16 inches? Will not a 51 gear on the stud, and a 41 gear on the screw, give the right pitch? A.—The gears mentioned certainly will not cut the required pitch. The number of threads to the inch is ascertained by the following statement in proportion:

$$1\tfrac{1}{16} : 1 :: 4 :$$

and when this is worked out, we get

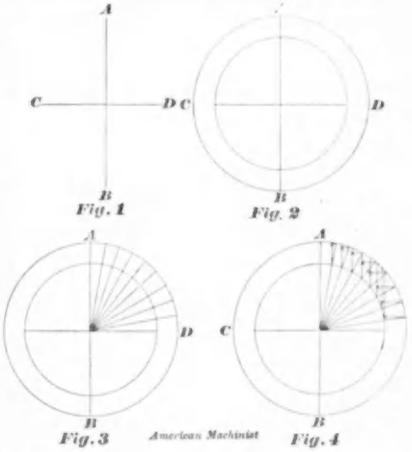
$$17 : 16 :: 4 : 3\tfrac{13}{17},$$ or, in decimals, 3.7647.

The thread cut by gears 51 and 41, mentioned above, will be:

$$51 : 41 :: 5 : 4.0196,$$

which is decidedly finer than the thread required. To ascertain the proper gears, it is only necessary to find two which shall have to each other the same ratio as the pitch of the lead screw bears to the thread to be cut; and in this case the mere statement of the case is its solution. As the respective threads are 5 and $3\tfrac{13}{17}$, or $\tfrac{85}{17}$ and $\tfrac{64}{17}$, if we take away the common denominator we have 85 and 64; and as these have no common divisor, gears with these numbers of teeth will be the smallest gears that can be used.

(25) R. W. J. S., Dalton, Ga., writes: I am interested in perspective drawing, and have picked up some ideas, and can make a good straight line perspective; but as most of my drawing is of machinery, I meet with some obstructions that I am not able to surmount intelligently. In making a perspective view of a pulley or gear by the straight line rule, I can get the perspective width and depth of a square representing the side of a pulley, but I have no rule for describing the ellipse on a scale small enough for my use. Can you help me? A.—To describe an



ellipse is really a simple and easy operation. The sketches show how to get the points for one quarter of the ellipse, and the rest is, of course, done in the same way. Say that *A B* and *C D* are, respectively, the long and the short diameters. With the point of intersection for a center, describe the two circles, Fig. 2, corresponding to those diameters. Draw at random any number of radial lines, Fig. 3, paying no attention to the equal spacing of them. From each point where one of the radii cuts the smaller circle, draw a perpendicular until it strikes the larger circle. From the points where the radii strike the larger circle, draw horizontal lines, each meeting its corresponding vertical line. These points of meeting will be the points of the required ellipse. The points for the remainder of the ellipse may be determined in the same way.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Adding Machine. Grant; see page 32.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, write Walter Donaldson & Co., Wash. D.C.

Model making and electrical experimental work. F. W. Gardam & Co., 58 Ann st., N. Y.

Engine castings ¼ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Aluminum and Brass Castings, Machinery, Name Plates. Twining Campbell, Paterson, N. J.

Brazing Wire and Bicycle Supplies; repairers and manufacturers; see Haines' ad. Ref. index.

Best Presses and Dies for all sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Just issued—Catalog No. 8. Mailed Free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Key Seaters for any length of hub or width of keyway. New, handy machines. Mitts & Merrill. 913 Tilden street, Saginaw, Mich.

"Hawkins' Aids to Engineers' Examinations, with Questions and Answers," $2 postpaid. Catalog free. Theo. Audel & Co., 91 Liberty St., N. Y.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, Tolland, Conn.

Thin emery wheels, for cutting slots, etc., a specialty. The Tanite Co., Stroudsburg, Pa.; 161 Washington street, New York; 139 East Pearl street, Cincinnati, O.

Some Recent Inventions in Metal-Working Machines.

SCREW MACHINE.

A screw machine, differing in some respects rather widely from other machines of this class, as shown in Figs. 1, 2, 3, 4 and 5, is the invention of Mr. C. E. Roberts, of Oak Park, Ill. Fig. 1 is a plan view; Figs. 2 and 3, sections on the lines 5-5 and 6-6 of Fig. 1, looking in the direction of the respective arrows; Fig. 4, a sectional view of the tool-head and its operating mechanism; and Fig. 5, a longitudinal section of one of the two stock-feeding and driving spindles.

A and A^1 are the usual tight and loose pulleys for the driving belt, the main shaft *a* carrying the pulley *N* (from which for certain classes of work the tool-head *G* is driven), and also the worm a^1 (Fig. 2), which drives the worm-wheel *B*, gears B^1, *C*, C^1 and *D*, the last-named being on the

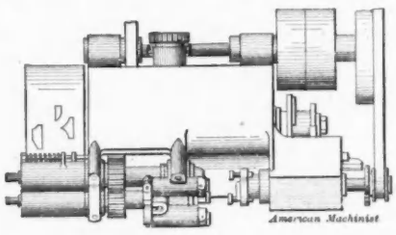


Fig. 1

main cam shaft in the bed of the machine. From this shaft are driven the cams D^1, J^3 and *K* (Fig. 1) and *R* (Fig. 3).

As will be seen in Figs. 2 and 3, the stock spindles and tool-head are inclined toward the front of the machine. From

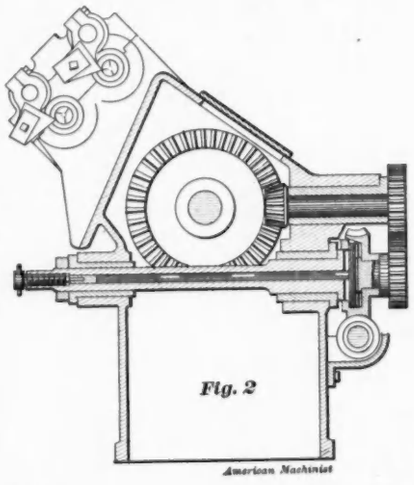


Fig. 2

this side, by means of the nut L^6 and screw L^4, all the stock-feeding and tool-head oscillating mechanism may be stopped, to be controlled by hand till the necessary adjustments are effected. The stock spindles are rotated by the pulleys *F* and F^1, gears F^2 and E^8.

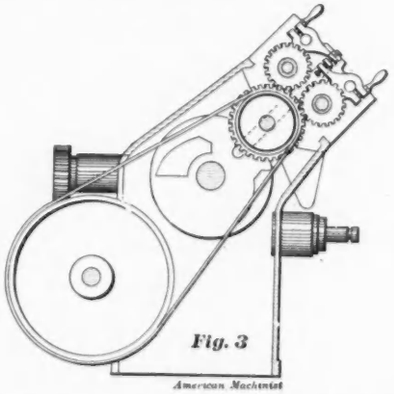


Fig. 3

These stock spindles being located side by side (see Figs. 1 and 3), are both similarly operated by the cam-pieces d^1, d^2, d^3 and the springs E^{14}. Turning now to Fig. 5, the feeding and chucking operation is as follows: The spindle *E* has no longitudinal motion, but carries the driving gear E^8 on the sleeve, having placed at either end thereof the bearings E^6, E^7. The roller d^5 on the sleeve E^9, being reciprocated by the cam-pieces d^2, d^3 (Fig. 1), operates (through the cone e^1 and arms E^{11}) to open and close the chuck E^4. Just previous to its opening, the split feeding spindle E^2 is retracted by d^1 and, immediately upon the opening of E^4,

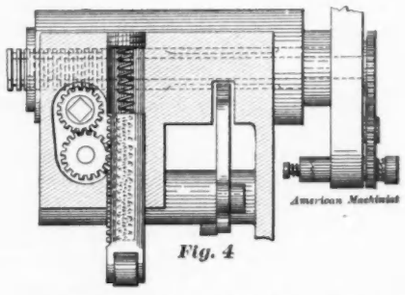


Fig. 4

is released from d^1 and fed forward by the spring E^{14} (Fig. 1).

The tool-holder movements as shown by Fig. 4, are, in some respects, unique. As stated above, one or both of the tools *O* may be rotated through *N*, M^1 and *H*. Without interfering with this rotation, the tool-head *G* is oscillated, to present the tools successively to each spindle, by the following means: The toothed arc *J* is rocked by the cam J^3, through the friction rollers J^4, J^5. *J* meshes with the long pinion j^1, to oscillate *G*; while the reciprocating rack K^1, gears K^4 and K^5 effect the longitudinal movement of the tool-head. For this purpose, pinion K^4 is made long, to allow K^1 to pass to one side of sleeve *H*; while the rack teeth of the latter are annular, to permit *G*'s oscillation.

Cutting-off tools are seen at *p* (Fig. 2),

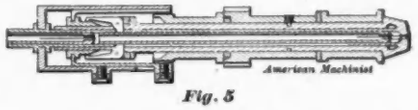


Fig. 5

which may be operated either by handles P^2 or by the cams *R*, R^1 and slider g^1 (Fig. 3). A bifurcated arm H^1 and a tapered guide lug H^2 (Fig. 1) insure exact alignment of the tools with the stock, after the oscillations of the tool-head.

FORM-TURNING MACHINE.

Figs. 6 and 7 show a forming lathe principally used for bicycle parts. The stock is passed in through the hollow spindle, the lower jaw of the chuck being permanently adjusted to the size of stock employed, while the upper jaw, operated by a differential screw, clamps it. The forming tools are in the rest close to the chuck; the roughing tools being horizontal in front, and the finishing tool nearly vertical at the back. The roughing tools are staggered to break the chip, and are independently adjusted. The forming tool is shaped to the profile of the finished work, and is sharpened by grinding on

the end. These tools are fed in and out by the right and left screw, the nuts of which may also be turned, to adjust the advance of the tools independently. The tools are fed in by the worm and wheel at the back, with an automatic stop, when the proper size is reached. Outside of the rest is a movable head, carrying the chuck jaws, which come up nearly close

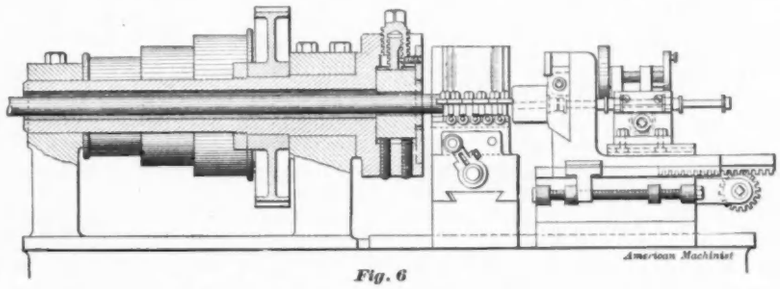


Fig. 6

to the forming tools. While the forming operation is in progress, these jaws serve as a steady rest for the piece previously formed; and they also clamp the piece and draw the stock along for the next piece, the movement of the head being determined by the stop nuts on the horizontal screw down in front. Upon this same head is still another pair of horizontally adjustable jaws, and outside of these is operated a reciprocating saw for cutting off the finished piece. The last

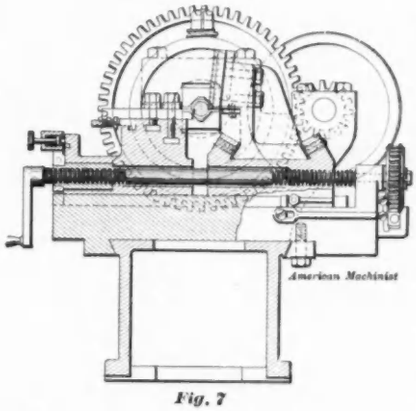


Fig. 7

finished piece is seen projecting to the right of the jaws, but the saw is not shown, only the little wrist-pin for operating it appearing.

The inventor of this is E. J. McClellan, New York City.

A fire occurred, Jan. 24, in the works of the Garvin Machine Company of this city. The flames were confined to the two upper stories of their extensive six story buildings, although the damage by water could not be so restricted, the loss in belting especially being enormous. The damages are estimated at $25,000. The fire will not seriously interfere with the business of the firm. A severe storm was prevailing at the time of the fire, and it is a coincidence that the buildings of this company were destroyed during the blizzard of 1888.

National Convention of Manufacturers —England's Foreign Banking System—A Department of Manufactures.

The first annual meeting of the National Convention of American Manufacturers met at Chicago last week, and the meeting was generally regarded as successful.

One of the most notable addresses delivered at the meeting was by Ulysses D. Eddy, of New York, in which he pointed out some of the things which contribute to England's success in foreign trade.

Chief among these he placed England's system of international banking, by which an English manufacturer is given almost if not quite as great facilities for doing business with a customer living on the other side of the globe as though he were in London.

"London possesses sixty incorporated banks exclusively devoted to international banking. Their aggregate capital is $294,000,000, their surplus $72,000,000, and their deposits exceed $1,200,000,000. These financial facilities are supplemented by private banking houses with a capital estimated to aggregate over $175,000,000, devoted in great part to foreign trade.

"With her banking system, England not only handles her own foreign commerce of over $3,000,000,000, but she also finances the larger part of the transactions between other countries, and may be said, through her banking organization, to make a profit on the trade of the world.

"Eighty million dollars of English banking capital is utilized in the trade with South America. One-quarter of this is applied to the commerce of Brazil, and is availed of by American importers in moving the coffee, rubber and sugar of that republic to the United States. You cannot drink a cup of coffee without paying a profit to a London banker."

The address was replete with valuable suggestions to American manufacturers, some of which, at least, will certainly have to be acted upon before they can occupy in foreign commerce the position which their skill and enterprise entitle them to.

The next convention will be held in Philadelphia at a date yet to be fixed. Theodore C. Search, President of the John B. Stetson Company, of Philadelphia, and founder of the Philadelphia Textile School, was chosen president for the ensuing year; and Robert Laidlaw and O. P. Wilson of Cincinnati, were re-elected treasurer and secretary, respectively.

A resolution was adopted, calling upon Congress to authorize the Interstate Commerce Commission to enforce a uniform classification of freight on all roads doing an interstate business.

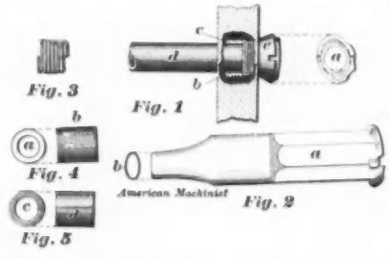
Another resolution adopted is as follows: "Resolved, That it is the sense of this convention that a department of manufactures be established under a secretary of equal rank with the Secretary of Agriculture, and that the Executive Committee be instructed to take such steps as may speedily accomplish said object."

This is in exact accordance with an editorial article published in the "American Machinist," May 11, 1893, in which some of the reasons why such a department of the Government should be established were set forth at some length.

Packing Condenser Tubes—Welded Boiler Shells.

BY JAMES F. HOBART.

A considerable addition has been made during the past few years in the making of surface condensers; in fact, the Lighthall pattern is now almost universally used, but, as the patents have expired, it is virtually everybody's condenser. This condenser, fitted with composition heads and screw glands, forms an excellent piece of apparatus, provided the heads are properly packed. The original Lighthall packing was made of paper; some engineers discard that material and use cor-



set lacing in its place. Lately, another form of packing has come up, which is even better than corset lacing.

Condenser tubes and glands are frequently misused, as illustrated in Fig. 1; at the end view *a* it will be noted that the screw gland and ends of the tube have been distorted and knocked out of shape to a considerable extent. The amount of distortion is seen at *c*, while *d* represents the tube projecting through the head, as shown. The spaces *c* and *b* show the quantity of packing that can be inserted between the head and screw gland. The distortion represented at *a* is caused by beading down a portion of the tube and gland, in order to prevent the tube from working out of place. It is usually done by means of a tool somewhat like that shown in Fig. 2, the body of the tool *a* being made of a piece of tool steel, and the points forged down to an oval sec-

tion, somewhat as shown at *b*. This tool is inserted in the end of each tube and struck one or two blows with the hammer, distorting the gland and tube, as shown.

This is a piece of needless work, almost approaching an act of vandalism; there is no need of thus spoiling a condenser tube. They will not work out of place if the packing is properly put in and screwed up. When corset lacing is used for packing, it is simply wound around the tube, each turn being driven home until it occupies the space shown

Fig. 6.

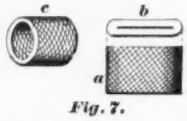


Fig. 7.

Fig. 8

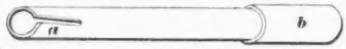


Fig. 9 American Machinist

at *c* and *b*, and in the form indicated by Fig. 3, that of a very compact spiral.

Another form of packing is made of paper cut out in disks, as shown at *a*, Fig. 4, being put together one on top of the other, as illustrated at *b*. This form of packing is not desirable. It is impossible to drive the paper tightly into place, or to make it stay in place when driven. The paper in this form is easily pulped. A much better form of paper packing is indicated by Fig. 5, *c* being an end and *d* a side view. This packing is made of a continuous piece of manilla paper, being rolled up upon an arbor, and then cut to the required length. Fig. 6 shows the position occupied by this packing in the condenser. The light portion in the middle is the paper, while a fiber washer is placed at either end of the quill. The screw gland and the head engage, respectively, each of the fiber washers and

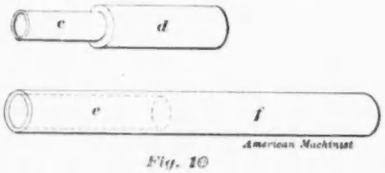


Fig. 10

prevent the paper from being damaged, however tightly the gland may be screwed home.

Another very good form of packing is shown by Fig. 7. It is made of soft cotton, and is woven diagonally, as shown. Once in place, this packing virtually takes the place of corset lacing, and is much easier in its application. It comes in the form shown by *a* and *b*, Fig. 7. In the gland it assumes the cylindrical form shown at *c*. In applying this packing, several lengths are threaded upon a long, limber stick, as shown by Fig. 8. The end of the stick, which is made small, is inserted in the end of a tube, and one of the packing rings slipped over the stick to the tube; the stick is then inserted in another tube, and another ring forced into place. It will be seen that this packing can be applied much quicker than either the lacing or the paper, and, when well driven home and the glands screwed tight, it leaves nothing to be desired.

For applying the corset lacing packing, a tool like that shown at Fig. 9 is necessary. It consists of a steel tube *a* inserted in a heavier tube *b*. The tube is slotted as shown, and one end of a piece of lacing being given a single turn around a tube, the end is dropped through this tool, which is then inserted into the gland with the corset lacing passing through the slot shown at *a*. A rotary motion is then given to the tool, which draws the lacing into place around the tube, at the same time a vigorous application of a machine hammer to the end of the tube at *b* drives each end of the lacing tightly into place.

In putting the paper fiber packing into place (that shown by Fig. 6), two tools are necessary, as shown by Fig. 10. The one shown at *c d* is known as a "slicker;" the end *c* is inserted in a tube, and the body of the tool *d* is of even diameter with the outside of the tube. A vulcanite ring is then slipped on *d*, the paper quill applied, and another fiber put on. It is well to apply the tool *e f* after putting the vulcanite fiber in place, and again after the paper quill has been put in, finishing with vigorous application after the second fiber has been put in place.

For screwing the gland in place, a tool should be provided which not only fits the inside of the tube, but also fits outside of it and extends down far enough to engage the gland. By doing this there will be no danger of tipping the gland so as to cross the threads; neither will the tube be pushed out of place or bent or otherwise distorted. The time saved by applying the circular textile packing is considerable over both the paper and the lacing. The paper can be applied in half the time necessary for the lace packing, while the circular packing shown at Fig 7 can be put in in one-fourth the time necessary for applying the paper.

The welded boiler shell is the boiler of the future. Even at present it enters largely into the specifications of the more advanced engineers. By the perfection of gas-welding apparatus, boiler shells, even of the largest diameter, can be so perfectly welded that the plate will break in any other place rather than at the weld. In making a weld it is unnecessary to scarf the edges of the plate; they will simply lap one upon the other; the weld plate and the lap rolled down to a proper thickness by means of specially designed rolls, which are usually actuated by hydraulic pressure, and can deliver any required force during the rolling act and touch any part of the boiler it is necessary to cover. This is best done by mounting the boiler upon a horizontal face plate, which is moved up and down by a hydraulic ram placed below it. A circular motion must also be given the face plate, preferably by means of a motor. A bed piece extends out from the face plate against which the shell of the boiler rests during the rolling act. A furnace is attached to the upper end of the bed piece, and another furnace is placed outside, immediately opposite the one noted.

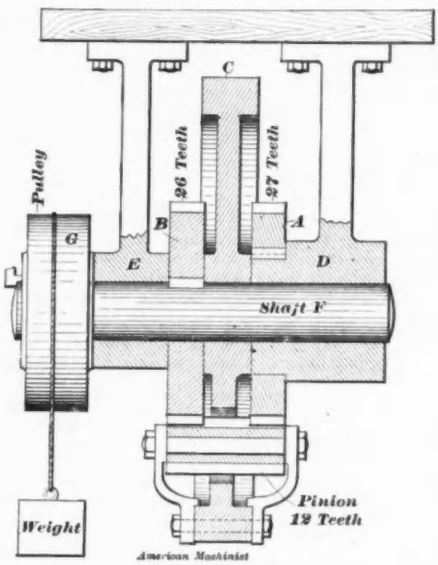
When welding a shell, heat is often applied inside and outside to the same point. As soon as the weld has been made, the hydraulic ram raises the face plate, bringing the head portion of the boiler between the roller and the bed piece. The roller being advanced by hydraulic pressure, the lap is very quickly rolled down to the thickness of the rest of the shell, and here is where the excellence of this method of welding becomes noticeable. Usually, in making a weld, the metal burns away on either side of the lap, and the sheet is left thin at this point. By the roller method of heating, the superabundance of metal in the lap is distorted, being forced out sideways on either end, and flows toward the thin portions where the action of the fire has reduced the sheet. By judicious manipulation of the roll and shell, the usual thin points can be made even thicker than the original shell if desired. The entire weld can be left a little thicker if it is deemed necessary to thus strengthen the weld. This, however, is not deemed necessary in cold-welding practice, and that part of the shell is left of even thickness with the rest, so that after a coat of oxide has gathered upon the shell it is impossible to detect where the weld is located.

A Differential Gear Question.

A correspondent writes as follows: "Suppose I have a shaft *F*, Fig. 1, supported in bearings *D* and *E*, and free to turn in them, with a pulley *G* keyed on the end, and a gear of twenty-six teeth also keyed to it, as shown, the diameter of the pulley *G* and the pitch diameter of the gear being about the same. Then, on the same shaft, but turning loosely, say that we have a wheel *C*, carrying a long or double pinion, with twelve teeth in each half, this pinion also being free to turn upon its shaft or pin, one end of it meshing into the 26-tooth gear, and the other end into a 27-tooth gear, which is keyed to the bearing *D* and does not turn. The pitches of the two gears and of the two ends of the pinion are not supposed to be precisely the same, but are made so that all will work correctly, the pitch of the 26-tooth gear and its end of the pinion being naturally a little coarser than the 27-tooth gear and its pinion. Now we can turn the wheel *C* and raise or lower the weight, as one tooth is gained or lost for each revolution of the wheel, the shaft turning in a

direction contrary to the wheel *C*; but if the weight were 1,000 pounds or 2,000 pounds, would it have power to turn the wheel, or what weight would turn the wheel, or could it be turned by any weight? How can the weight required be calculated?"

This is one of the questions which may be taken to illustrate the difference between theory and practice. Theoretically, the weight on the wheel *G* should turn the wheel *C*; practically it is pretty safe to say that it would not, because the friction of the apparatus would be sufficient to check its movement. A large weight would probably have no



more success than a smaller one, as the friction would increase in nearly the same proportion as the weight.

Many a "practical" man would answer the above question in this way, and think it all-sufficient; but in this case, the theory of the practical man is more or less defective or incomplete, and therefore does not cover the case. It is possible to show that while the weight would not drive the train, it would be defeated by other conditions, if not by the friction. The sketch, Fig. 2, is a plan of the gears with the pinion drawn in correct proportion to the other gears. Assuming the diametral pitch of the 26-tooth gear and its 12-tooth pinion to be ¼ inch, the scale of Fig. 2 is one-half. The diametral pitch being ¼ inch, the radial pitch will be ⅛ inch; and the pitch radius of the 26-tooth gear will be $26\times\frac{1}{8}''=3\frac{1}{4}''$, and that of the pinion will be $12\times\frac{1}{8}''=1\frac{1}{2}''$, and the distance from the center of the main shaft to the center of the pinion will be $3\frac{1}{4}''+1\frac{1}{2}''=4\frac{3}{4}''$. It is understood that the pitch of the 27-tooth gear and its pinion is necessarily different from this. The radial pitch for these is obtained by dividing the distance between the centers, $4\frac{3}{4}''$, by the sum of the teeth: $4\frac{3}{4}''\div(27+12)=.121795$; and this radial pitch multiplied by 27 gives 3.288, or, say, 3.29, for the pitch radius of the 27-tooth gear, and $.121795\times12=1.46$ for the pitch radius of its pinion; the sum of these being 4.75, as required.

The pitch dimensions of the gears being thus ascertained, we can better understand their operation by considering them simply as levers which, in fact, for any isolated movement, they are; and for continuous running they are only levers continuously replaced. Also, as the pinion is kept rigidly parallel by its bearings, the action of the gears, or levers, is the same as if they were in the same plane. The 27-tooth gear being fixed, its pitch line is a fulcrum, and the pinion becomes a simple lever, with the pitch line of the 26-tooth gear, 1, for the place where the power is applied; the pitch line, 2, of the 27-tooth gear for the fulcrum; and the center of the pinion as the end of the lever where the work is done—the work in this case being the turning, or the attempt to turn, the wheel *C*. The length of the short arm of the lever, it will be seen, is .04, while the length of the long arm is 1.46.

In the shortness of the short arm of the lever is a sufficient explanation why this train of differential gears, or any similar train, will not work reversed. If the fulcrum, or the pitch line of the fixed gear, were a knife edge, and if the point of contact at the pitch line of the 26-tooth gear were a knife edge also, it would be possible for the lever to work; but the tooth faces are approximately flat at the point of contact, so that their actual bearing against each other, whatever it may be in theory, is not in practice a sharp, straight line, and a leverage as short as $\frac{1}{100}$ is annihilated and cannot possibly have any operative effect. The center of the bearing is, of course, upon the average, at the pitch line; but if the bearing were only 1-16 inch, it would be 1½ times the length of the short arm of the lever, so that the lever could not be expected to work under the circumstances.

The Pratt & Whitney Co. have completed special machinery for making decimal gages for measuring sheet-metal tubes and wire, adopted by the Railway Master Mechanics' Association. We are informed that about 500 gages have been ordered, several of the leading railroads having made this gage their standard, and there is every reason for believing that within a few years it will be practically universal.

The Secretary of the Navy has invited bids for gun forgings for the batteries of the ships "Kearsarge" and "Kentucky." There will be eight sets of rough-bored and turned forgings for 13-inch rifles, and eight sets for 8-inch rifles. As soon as these forgings are delivered there will be some work for the ordnance shops at Washington.

Recent developments of photographing through substances hitherto considered entirely opaque, may lead to something of importance to mechanics. A photograph of the interior of a boiler when steaming, for instance, might not be uninteresting.

As a result of having been cheated in some purchases of guns during their late so-called "war" with the Japanese, it is said the Chinese will establish gun factories of their own.

COMMERCIAL REVIEW.

NEW YORK, SATURDAY EVENING, JAN. 25.

Machinery and Supplies.

In the midst of conflicting reports, we are inclined to hold that although factories may be very busy, iron working machinery in this market is not, since the first of the year, reaching consumers quite so rapidly as in December. But the feeling is that more business is bound to come, and some of it is expected next month. That the gradual improvement, which is acknowledged to be taking place, is so slight is attributed still to public lack of confidence, and some people look to politics for an explanation. While leaving this delicate subject to individual judgment, let us remark that this is a Presidential election year, and it is to be expected that, for that reason, trade will be hampered throughout. The Davis & Egan Machine Tool Co. report from Cincinnati an exceptionally good business for this time of year. A market is opening up in England, Germany and France, bicycle manufacturing tools being among those for which there is a foreign inquiry. The company has now on hand enough work to employ its shops until March 1st.

If wood pulleys are any criterion of trade, indications seem favorable. A company making these has had a most prosperous year opening. This must be largely attributed, however, to the growing popularity of this line of goods, which is proving a formidable rival of iron pulleys, though it is impossible that the latter will ever be entirely supplanted, as they are available in places of exposure to steam or acid, where wood must suffer injury.

There is still considerable retardation in the selling of machinists' supplies, taken as a class, and prices have a weak tendency. This must not be taken as reflecting unfavorably upon every line of goods, such as twist drills, which might be mentioned under this comprehensive head.

Engines, Boilers and Pumps.

Symptoms, at least, are manifest of a slightly improving tone among the engine and boiler trade. There is considerable prospective business, and a steady improvement is anticipated, until the dull summer period. Building contractors are making ready for their spring work,

and plans are being filed, which means that orders for steam plants must follow. A line of engines said to be in increasing demand is those of from 15 to 25 horse-power, designed for running direct connected electric light dynamos.

Steam pumps are not active, even for this season of the year, nor is the number of inquiries especially great. Cuban disturbances have somewhat curtailed the export trade, and business is rather quiet around New York City.

Recording instruments for gaging steam pressure, and other purposes—a class of specialties which in the autumn were moving with some celerity—are now going at a pace which seems to illustrate a present hesitation of the public to invest in the more luxurious kinds of goods.

Iron and Other Metals.

The pig iron situation seems to be brightening, though slowly. People who have held off expecting lower prices are disappointed and there is considerable inquiry with some selling, though the latter is not yet very free. Bessemer is quoted as high as $12.50 Valley. It already feels the effect of ore at $4.00 per ton, and coke at $2.00 for furnace and $2.30 for foundry. With higher prices for Bessemer, foundry furnaces may begin to manufacture it, and this will have a beneficial effect upon foundry irons.

The manufacturers of cold rolled steel shafting, who are united in a somewhat informal association, are to meet in Boston on Tuesday, January 28th, and it is expected that there will be an increase made in prices, to go into effect February 1st. Trade continues steady and fairly good, being better than earlier in the month. The same may be said of business in tool and machinery steel.

Copper has been rather healthier in tone than last week. Though business has not been transacted on a notably large scale, exports to Europe continue heavy, and sellers are becoming more conservative in offers.

Pig tin has been in a trifle better selling in this market, at prices which have shown little fluctuation.

Pig lead has been rather quiet and the amount sold contrasts sharply with that which changed hands earlier in the month. The price has undergone no great alteration.

Spelter, though in moderate selling, has been firm in price. The combination of producers is said to be practically effected.

QUOTATIONS.

NEW YORK, Monday, January 27th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$13 00 @ $13 50
No. 2 foundry, Northern	12 00 @ 12 50
No. 2 plain, Northern	11 25 @ 11 75
Gray Forge	12 00 @ 12 50
No. 1 foundry, Southern	12 50 @ 12 75
No. 2 foundry, Southern	12 00 @ 12 50
No. 3 foundry, Southern	11 75 @ 12 00
No. 1 soft, Southern	12 25 @ 12 50
No. 2 soft, Southern	11 75 @ 12 00
Foundry forge, Southern	11 25 @ 11 75

Bar Iron—Mill price, on dock: common, 1.25 @ 1.35c.; refined, 1.35 @ 1.50c.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—About 1.55c. in carloads mill price; from store, ¼c. advance. Special brands upward.

Cold Rolled Steel Shafting—Base, 2½c. in carloads; 2¾c. in smaller quantities; 3c. from store.

Copper, Wholesale Lots—Lake Superior ingot, 9⅞ @ 10c.; electrolytic, 9½c.; casting copper, 9¼ @ 9⅜c., according to brand.

Pig Tin—For 10-ton lots, 13.30c.

Pig Lead—In carloads, 3.05 @ 3.07½c.

Spelter—Western brands, 4.05 @ 4.10c., New York delivery.

Antimony—In wholesale lots, Cookson's, 7¾ @ 7¾c.; Hallett's, 6¾ @ 7c.; Japanese, 6¾ @ 6¾c.

Lard Oil—Prime city, present make, 52 @ 54c. in large quantities.

NEW CATALOGS.

There are three sizes of Standard Catalogs, 9"X12", 6" X 9" and 4½" X 6". We recommend the 6" X 9" size for machinery catalogs. When they must be larger or smaller, one or the other standard sizes should be adopted if possible.

Buffalo Forge Co., Buffalo, N. Y., are sending out two pamphlets, one of which is entitled, "A French Iron Foundry in 1789," and the other, "Air as an Industrial Factor." These are of historical and some practical interest to manufacturers and engineers.

Betts Machine Co., Wilmington, Del., have issued a pamphlet devoted entirely to the illustration and description of their various sizes and styles of planing machines. Excellent half-tone engravings show how the planers appear, and the book is well gotten up. It is 9¾ x 6¾ inches.

The Standard Boiler Co., Chicago, Ill., send us a catalog in which are a number of fine illustrations of various forms of their water tube safety boiler and of the establishment in which it is manufactured. The catalog is well printed, and has an unusually handsome cover. It is 6¾ x 9¼ inches.

The Deering Harvester Co., Chicago, Ill., send us a pamphlet entitled "Roller and Ball Bearings on the Farm." This pamphlet is devoted to setting forth the results of the experience of the company named in the use of roller and ball bearings on agricultural machinery, and will be found interesting to those who have to do with machine construction as well as to farmers. It is sent on application, and is 8 x 9¾ inches.

Hine & Robertson Co., 68 Cortlandt street, New York City, have issued a pamphlet setting forth the merits of various engineers' appliances made by them, which include indicators, planimeters, reducing wheels, damper regulators, the Hine eliminator, and many other devices used about the engine room. The pamphlet contains matter of interest to practical engineers, and will be sent to all who apply for it. It is 4½ x 6 inches.

The Prentiss Tool & Supply Co., Chicago and New York, have issued a catalog in which are illustrations and descriptions of machine tools and other appliances particularly adapted to manufacturing bicycles. These include not only the standard machine tools, especially adapted to this service, but a good many other special tools and appliances besides, and the catalog will be found interesting to all who have to do with manufacturing or repairing cycles. It is standard size, 6 x 9 inches.

MANUFACTURES.

Trump Bros., of Wilmington, Del., have been operating their works day and night for over a year.

The Singer Bicycle Co., of Coventry, Eng., are to commence a branch factory at South Framingham, Mass., soon.

The Mitchell Heater Co., Poughkeepsie, N. Y., was recently formed by Chas. Mitchell, F. B. Lown, and others. The capital is $50,000.

The Midland Foundry and Machine Co., of Denver, Col., has been formed. Capital $40,000. Incorporators, Thos. C., A. H. and T. C. Walker, Jr.

The Lorentz Cigarette Machine Co. has been organized at Jersey City, N. J., with a capital of $200,000. Incorporators are Lorenzo D. Lorentz and Woodville Flemming.

The Pratt & Whitney Company's Boston office has been removed from 47 Pearl street, to 281 Franklin street, corner of Hamilton, where a large stock of machine and small tools will be carried.

The McDougall & Potter Co., of New York, has been formed to manufacture machinery and iron work. It has a capital of $50,000, and the incorporators are Reginald Steel and James M. Potter.

The United States Projectile Co., of Brooklyn, N. Y., has secured a contract for making 4,000 8-inch shells for the navy. They will be what are known as "semi-armor piercing shells," and will weigh in the rough state about 300 pounds each. The contract price is $27.25 each.

The power house for the Brunswick Traction Co., at Milltown, N. J., will be furnished by the Berlin Iron Bridge Co., of East Berlin Conn. The engine room will be 64 feet long and 85 feet wide, and the boiler room 45 feet wide and 48 feet long. The side walls are of brick and the roof trusses of iron.

A correspondent living in Norwich, Conn., informs us that there are four shops in that town making bicycle chains, and that they are turning out about a thousand per day. C. B. Rogers & Co., who make wood-working machinery there, are running full-handed and until 9 P.M., and all the shops and mills are running full time.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Situation by first-class moulder on green, dry, sand or loam, or as foreman. BOX 7, AM. MACH.

Wanted—Few draftsmen on Corliss engine work. Address D. 70, care AMERICAN MACHINIST.

Sit. wanted, hyd. and spec. mch. designer; tech. educa.; can take charge room. Box 12, AM. MACH.

Wanted—First-class machinists (close workmen). At the works of the Vermont Farm Machine Co., Bellows Falls, Vt.

Wanted—Position as superintendent or draftsman of machine works, by experienced man. Address BOX 17, AMERICAN MACHINIST.

An experienced steam pump salesman and engineer now open for engagement, east or west. Address BOX 24, AMERICAN MACHINIST.

Wanted—Fifty first-class machinists, vise-hands, lathe and planer hands. Apply to the Lodge & Davis Machine Tool Co., Cincinnati, O.

Superintendent wanted in a machine screw shop doing considerable bicycle work; only first-class men need apply. "Cleveland," AM. MACHINIST.

Wanted—Situation by experienced machinist and tool maker, as foreman of machine shop or bicycle works. Address BOX 26, AMERICAN MACHINIST.

Wanted—A change of foremanship by a first-class man. At present a foreman in a large engine works. Address J. H. H., care AM. MACHINIST.

Wanted—A good machine tool man as the contractor for the output of entire plant. A good opening for the right man. Box 15, AM. MACH.

Machinists Wanted—Must be experts on milling and grinding machines. Apply to Hoffman Machine Co., 143d street and Amsterdam avenue.

Mech'l draftsman, technical education drawing-room and shop education, will be open for engagement about Feb. 1. Address BOX 25, AM. MACH.

Mech. dftsman, prac. and theo. educated, exp. designer of mach. and tools for the economic prod. of work, open for engagement. P. T., AM. MACH.

Wanted—Ass't draftsman on power pump work. State age, exp. & salary expected, also references. Tech. grad. preferred. Address Box 2291, N. Y. City.

Foreman pattern maker desires a change; 5 yrs. exp. as f'man large concern build. hvy. mch.; has economic methods; age 39. Box 11, Am. Machinist.

Position wanted by tech. man, exp. in manufacture, from drawing room to installation, of steam, hyd. and elec. pow. mach. Add. Box 18, Am. Mach.

A mechanical engineer, successful designer and first-class draftsman now open for engagement; 20 years' varied experience; specialty, high-grade engines. Address Box 263, Ridgway, Pa.

Situation by a first-class gear cutter and machinist—Have had four years' experience in gear cutting. Would like to take charge of a gear-cutting department. Box 27, American Machinist.

Position wanted by good mechanical draftsman and designer experienced on automatic and general machinery. 12 yrs. practical experience in shop and drawing room. Address Box 16, Am. Mach.

A practical draftsman and designer with technical education and shop experience, wants position as assistant to mechanical engineer or factory supt. Gas engines a specialty. Address S. B., Am. Mach.

Ambitious young man, practical machinist, with thorough business exp. and knowl. of hardware, desires position as salesman, references unquestionable. Address W. E. S., 181 Ave. D, Bayonne, N. J.

Mechanical eng. and draftsman wants a position; steam pumps, wood and brass working mach., elec. mach., sugar mach., power transmission special mach. Technical graduate and shop experience. Age, 30. Box 22, American Machinist.

Mechanical engineer, American, age 29, tech. grad., experienced constructor on ice mach'y, Corliss, steam and gas engines, wants position as engineer or constructor; highest-class references as to ability and character. Box 8, Am. Mach.

Foundry Foreman Wanting a Situation—Has had 30 years' good experience in the practical knowledge of loam, dry and green sand. Marine work preferred. Good references given from last employer. Address R. Watson 25 Birch st., Cleveland, O.

Mech. Engineer, 20 yrs. prac. in bld'ng & erecting mach., bld'ngs, etc., for rolling mill steel plant and structural iron work, wants position; exp. covers steam, electric, pneumatic and hydraulic installations; memb. A.S.M.E. Address Box 28, Am. Mach.

Change of place wanted by man with wide experience, large and small work, in factories, shops, drawing rooms, foundry. Understands mixing iron, keeping casts and handling labor economically. Member A. S. M. E. Ref. Add. Box 23, Am. Mach.

Wanted—Foreman for assembling department; one who has had large experience on bicycles, both at assembling and machine work; must be competent to handle men and a "hustler." Address with full particulars in regard to experience, wages, &c., George N. Pierce & Co., Buffalo, N. Y.

Wanted—A young, energetic man as foreman of a mach. shop employing from 15 to 20 machinists, shop located in Western Penn. Give reference, age, nationality & knowledge of mechanical drawing & state where last was acquired; also state wages wanted. Address B., care Am. Mach. Pub. Co.

MISCELLANEOUS WANTS.

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header made by C. H. Baush & Sons, Holyoke, Mass.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden st., Saginaw, Mich.

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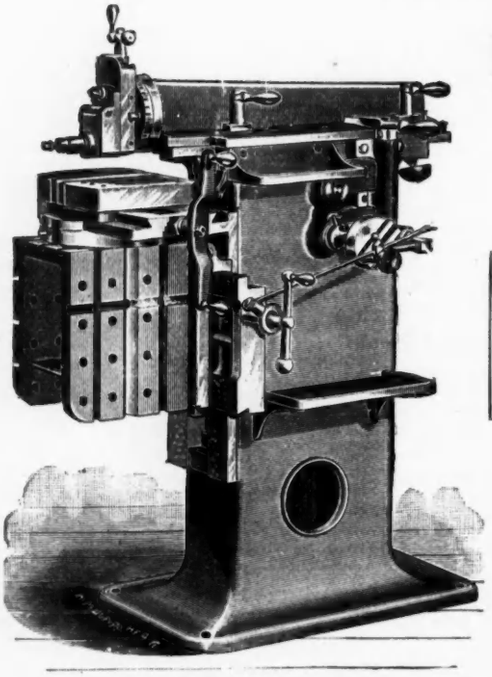

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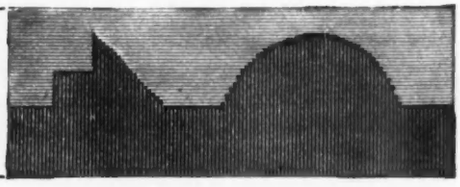

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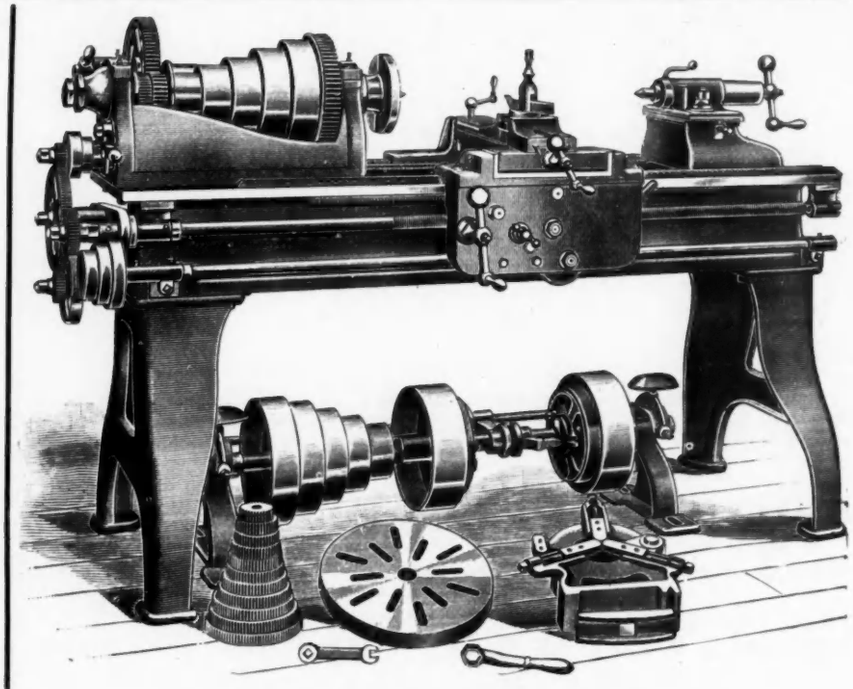

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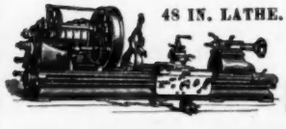

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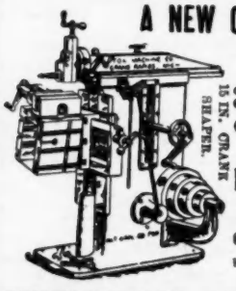

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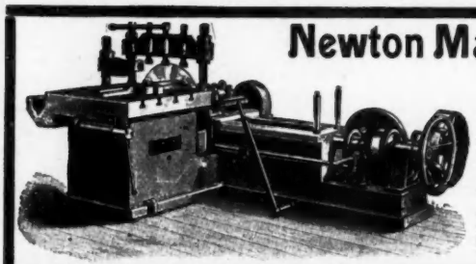

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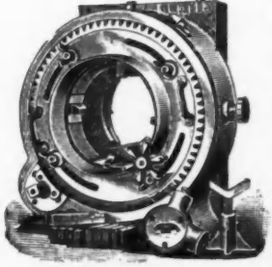
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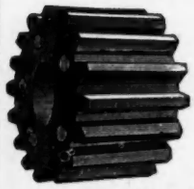

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